This Bulletin is an official publication of the extension service of the Bureau of Sugar Experiment Stations, issued and forwarded by the Bureau to all cane growers in Queensland.

The
Cane Growers' Quarterly
— Bulletin —

VOL. XI 1 OCTOBER, 1947 No. 2

A Further Review and Comparison of Fertilizer Trials in North Queensland during 1932-36 and 1937-41.*

By L. G. VALLANCE.

Introduction.

SINCE the fertilizer trials on the sugar-cane soils of North Queensland were reviewed by Kerr [2] in 1937 the results of a further five years of experimentation are available. Unfortunately this work was sharply curtailed in 1942 and a resumption on any appreciable scale was not possible until last year. During this latter period the scarcity of fertilizer will undoubtedly have accentuated the particular deficiencies of the various soils. In consequence, therefore, it will be necessary to continue the field trial work and because of this the general trends of responses to nitrogen, phosphate, and potash are of particular interest..

Comparison of Responses to Fertilizer, 1932-36 and 1937-41.

It is interesting to compare the results of the application of fertilizers to these North Queensland soils during the two five-yearly periods, 1932-36 and 1937-41. The experimental methods and amounts of fertilizer used are essentially the same and the various soil types are reasonably represented throughout. The comparative figures are given in the following table:—

YIELD INCREASES.—TONS OF CANE PER ACRE.

Increase due to—			1932-36 (47 trials).	1937-41 (44 trials).
Nitrogen	—	Plant Cane	2·0	1·1
,,	—	Ratoon Cane	7·6	7·0
Phosphate	—	Plant Cane	2·7	3·3
,,	—	Ratoon Cane	2·0	2·6
Potash	—	Plant Cane	1·6	4·2
,,	—	Ratoon Cane	2·3	2·3

Nitrogen.—The large increase in yield due to nitrogen when applied to the ratoon crop is again emphasised, and, in general, the response has neither increased nor diminished during the decade. The corresponding

* Paper presented at the Innisfail Conference, Q.S.S.C.T., May, 1947.

responses for plant cane are also essentially the same; the small difference of less than 1 ton between the two periods is not significant. Since the nitrogen requirement of a soil is a reflection of its humus and organic matter content the similarity of the responses throughout the two five-yearly periods is interesting. It would appear that nitrogen was just as effective in promoting growth in the latter period as in the former. A reasonable conclusion is that the capacity of these soils to produce, or what may be regarded as their inherent fertility, has not been seriously impaired by continuous cultivation during the ten years under review.

Since many of the trials were carried out on farms where the growing of legumes for ploughing-in is practised, the small increase in yield due to the application of nitrogen to plant cane as compared with that of ratoons is again a striking argument in favour of green manuring. Unfortunately, sufficient details are not available to allow an over-all comparison of green-manured versus non-green-manured plots. However, very substantial increases due to nitrogen were obtained from plant cane which had not had a leguminous crop turned in prior to planting.

Phosphate.—There is no apparent change in the response to the application of phosphatic fertilizers. The small increase of 0.6 tons per acre in both plant and ratoon crops is not significant. Unlike the response to nitrogen, it would appear that there is no essential difference in the phosphate requirements of plant and ratoon cane.

Potash.—The figures for response to potash as shown in the previous table are somewhat misleading in that, during 1937-1941, there occurred a large increase in yields of plant cane due to the application of potash. This is readily explained by the fact that during the latter part of the period, attention was focussed on the potash requirement of the red volcanic soils. Accordingly, a large number of trials were set out on these soils, which are very deficient in potash, and the results have very much influenced the average yield increases due to this fertilizer. However, a study of all the available figures indicates that there has been no marked increase in the potash requirement of plant cane during the 10 years. This is also true for ratoon crops, where a yield increase of 2.3 tons per acre prevailed during both periods, and no doubt because of the more even distribution over the various soil types, these ratoon figures are more truly typical.

Response to Fertilizer of the Various Soils.

The soils of North Queensland fall naturally into four main classes: (1) Alluvials; (2) Schist Soils; (3) Red Volcanic Soils; and (4) Residual Soils. They differ considerably both in origin and constitution and the salient characteristics of the various types have been described in detail at previous meetings of this Society [1. 3.]. As would be expected they also differ in fertilizer requirement and, therefore, in considering the results of fertilizer trials, it is necessary to review the responses of the various soils separately.

Alluvials.—The alluvials constitute the major soil group of the cane-growing areas. There are many variants and considerable differences occur in texture, colour and depth. They also differ pedogenetically and may be classified according to the type of parent material which may be of granitic, schistose or mixed origin. However,

sufficient information is not available to subdivide the fertility trials according to these type variations; nor is it particularly necessary inasmuch as the plant food deficiencies exhibit fairly well defined trends, which are general throughout the whole group of soils classed as alluvials. In order to illustrate these trends the average responses to the various plant foods are given in the following table. These figures were obtained from a considerable number of fertilizer trials carried out on the alluvial soils during the period 1937-1941.

Yield Increases.—Tons of Cane per Acre.

Increase due to—	Plant Cane.	Ratoon Cane.
Nitrogen	2·1	7·4
Phosphate	3·2	1·8
Potash	1·4	1·3

As has been previously pointed out, the greatest response is still that given by the application of nitrogen to ratoon crops. The average increase in yield due to the use of this fertilizer on plant cane has again been considerably diminished by the fact that many of the trials were green-manured prior to planting.

Most of the trials showed a fairly substantial increase in yield due to phosphate. The rather low yield increase suggested by the average figure for ratoon crops is not typical and is probably due to the fact that some of the ratoon trials were set out on blocks, which had been adequately fertilized with superphosphate in previous years.

A slight but fairly definite increase resulting from the application of potash was also noted and there was little difference in this respect between plant and ratoon crops. Generally, the alluvial soils do not show any marked potash deficiency and they appear to respond better to phosphate than potash. Therefore, as previously recommended, Sugar Bureau Mixture No. 1 is again advised for these soils. A suitable rate is three and a half cwt. per acre of the planting mixture for plant cane and a slightly heavier dressing of Sugar Bureau No. 1 Ratooning Mixture for ratoons. Under certain conditions Sugar Bureau No. 2 Mixture may be a useful alternative mixture, and the relevant remarks made in respect of the residual soils (see later) apply equally well to the alluvials. It is absolutely essential to top-dress all ratoons with sulphate of ammonia at the rate of two to two and a half bags per acre. A good crop of green manure ploughed in prior to planting will usually supply the nitrogen requirements of the plant crop, otherwise a top-dressing of sulphate of ammonia at approximately one and a half to two bags per acre is advisable.

Schist Soils.—These soils form a large series, varying considerably in texture and colour. They are, however, definitely residual soils, having been formed *in situ* from the underlying schist and related rock. Because of the extensive area covered by the schist soils and the many variations which occur, a large number of fertilizer experiments has been carried out on them. The results obtained during the five years under review are in the main similar to those obtained during previous years of experimentation.

Once again the results indicate that by far the greatest response to fertilizer is that due to nitrogen. Out of eleven ratoon crops which were harvested, not one failed to show substantially increased yields due to top-dressing with ammonium sulphate. Moreover, the yield of plant cane from every field which was not green manured prior to planting was also appreciably increased by the application of this fertilizer. Furthermore, the value of green manuring was again demonstrated by the fact that, with one exception, the turning-in of a legume supplied the nitrogen requirements of the plant crop. The exception occurred on a white schist loam (see following Table) and even on this soil type, which is particularly deficient in organic matter, the increased yield due to the application was only slightly greater than that which was obtained by green manuring alone. In order to illustrate the necessity for the top-dressing of ratoons and also the value of green manuring nitrogen-deficient soils, the results obtained from three typical trials are given in the following table. These three trials were all green manured prior to planting.

Increase in Yield due to 3½-Cwt. Sulphate of Ammonia.—Tons per Acre.

Soil Type.	Plant.	First Ratoon.	Second Ratoon.
Red Schist Loam	nil	3·3	13·0
Brown Schist Loam	nil	18·0	14·0
White Schist Loam	1·8	5·8	5·6

Out of some 19 trials in which the response to phosphate was tested, 12 of them showed a slight response. None of the increases was substantial and it must be concluded that these schist soils are not generally markedly deficient in phosphate. However, the majority of the experiments suggest that the phosphate content is on the border line, and presumably continued cropping will further deplete the soil reserves. Therefore, a fertilizer mixture containing a suitable percentage of phosphate—e.g., Sugar Bureau Mixture No. 2—should be used.

Unlike the trials which were carried out on the red volcanics the experiments on these schist soils showed no outstanding increase in yields due to the application of potash. In fact, the results were very similar to those obtained with phosphate and a little over half of the trials showed slight increases, with varying degrees of definiteness. Because of this, the use of a fertilizer mixture containing moderate amounts of potash is advisable.

It would appear, therefore, that there is no necessity to revise the previously issued fertilizer recommendations for these soils, which are, in general, as follows:—Sugar Bureau No. 2 Planting Mixture at the rate of three cwt. for plant cane, or Sugar Bureau No. 2 Ratooning Mixture for ratoons at four cwt. per acre. It is extremely important to top-dress all ratoon crops with sulphate of ammonia at the rate of two to two and a half bags per acre. Plant cane should receive this fertilizer at the rate of one and a half to two bags per acre, unless a very good leguminous crop has been turned in before planting, in which case no sulphate of ammonia will be required.

Red Volcanic Soils.—An outstanding feature of seven plant crop trials on the red volcanic soils was the lack of response to nitrogen. This was undoubtedly due to the fact that each experimental block had had a green manure crop turned in prior to planting. Unfortunately, it was not possible to continue these trials beyond the plant crop except in one instance, and in this case the effect of the leguminous cover crop was still evident in that no nitrogen was required for the first ratoon. However, a residual effect of this magnitude is rather unusual and it is sound practice to top-dress all ratoon crops. In general, also, where for some reason a successful leguminous crop has not been grown prior to planting, a top-dressing of sulphate of ammonia is always recommended.

Only two trials out of eight showed slight responses to phosphate. This is completely in accord with previous work and, as has been repeatedly stressed, fertilizer mixtures containing high amounts of phosphates are not required for these red volcanic soils. However, it is of interest to note that a fertility survey of the Garradunga area [4], which was completed in 1945, indicated that some of the red volcanic fields now contain rather lower amounts of available phosphate than might be expected. Therefore, although substantial dressings of phosphate are not required, a fertilizer mixture containing small to moderate amounts is advisable. Sugar Bureau Mixture No. 3 is suitable, but on blocks that have consistently received this high potash mixture for years an alternative dressing of Sugar Bureau No. 2 (which contains more phosphate) might be advantageous. However, because of the urgent potash requirement of these soils, and the probable after-effect of fertilizer rationing, any grower who contemplates discarding No. 3 Mixture is strongly recommended to have his soil analysed before any change is made.

The trials set out during the 1937-41 period have again borne out the fact that potash is the major plant food requirement of the red volcanics. The figures set out in the following table from some typical trials indicate the yield increases due to the application of potash.

Yield of Cane.—Tons per Acre.

District.	No Potash.	Potash.	
		1 bag per acre.	2 bags per acre.
Daradgee (Plant)	9·4	21·1	22·2
Innisfail (Plant)	30·2	34·2	34·0
South Johnstone (Plant)	34·8	39·4	39·6
Garradunga (Plant)	11·5	29·8	23·4
South Johnstone (Ratoon.)	23·3	26·3	27·3

A further trial worthy of mention in the Garradunga area indicated that a dressing of 300 lb. muriate of potash was responsible for an increase of 18.4 tons of cane per acre, converting a certain crop failure into a satisfactory yield. In this experiment an additional 300 lb. of potash, making 600 lb. in all, provided a further, but slight, increase of 1.2 tons. A similar trial gave a response of 8.3 tons cane per acre for the first 300 lb. of muriate of potash, with no further benefit for the second 300 lb. In general, the evidence of many trials suggests that

about two to two and a half cwt. muriate of potash is about the economic application, particularly in view of the present price of this material. This is equivalent to approximately four to five cwt. of Sugar Bureau Mixture No. 3.

In view of the above results it would appear, therefore, that a high potash mixture is still the most suitable fertilizer for the red volcanics. Sugar Bureau No. 3 Planting Mixture should be used at the rate of four cwt. per acre for planting and Sugar Bureau No. 3 Ratooning Mixture at five cwt. per acre for ratoons. Provided a good green manure crop has been turned in prior to planting, no top-dressing is required for plant cane, otherwise an application of one bag (160 lb.) sulphate of ammonia is advisable. For all ratoons a somewhat heavier dressing of one and a half bags per acre is recommended.

Residual Soils (*Sandy and Gravelly Loams*).—These soils are characterized by their coarse-grained texture, which is usually that of a sandy or gravelly loam. Because of the low clay and organic matter content their moisture-holding capacity is low and crops are quickly influenced by seasonal conditions. However, in good rainfall areas, excellent response to fertilizer is obtained and satisfactory crops are produced.

The results of the fertilizer trials conducted on these soils during 1937-41 are completely in line with those that were obtained in many previous experiments. In order to illustrate the general nature of the responses obtained by the application of fertilizer the result of a typical experiment is given in the following table:—

Fertility Trial.—Tully.

Fertilizer per acre.	Increase—tons cane per acre.	
	Plant Cane.	Ratoon Cane.
175 lb. Ammonium Sulphate	2·0	3·2
350 lb. Ammonium Sulphate	4·7	4·9
200 lb. Superphosphate	0	0
400 lb. Superphosphate	1·7	0·4
150 lb. Muriate of Potash	3·6	1·6
300 lb. Muriate of Potash	2·5	1·0

That these soils are very deficient in nitrogen is again indicated by the fact that the above trial, in common with all others that were conducted, showed substantial increases due to the application of ammonium sulphate. This trial showed a rather indefinite response to phosphate and a somewhat erratic one to potash. This is typical of the many experiments carried out since; although a response to both phospate and potash was usually obtained, the increases were never marked. However, the fact that these soils require a certain amount of these two materials suggests that unless they are supplied for each crop a definite deficiency may ultimately arise. Therefore, a dressing of Sugar Bureau No. 1 Mixture is recommended at the rate of three to four cwt. per acre or, alternatively, a somewhat lighter dressing of Sugar Bureau No. 2 at two and a half to three cwt. per acre. In view of the possible effect of fertilizer rationing and the fact that very low amounts of potash have been used on these soils for the past six years it would not be surprising

if substantial responses were obtained from potash applications. Because of this, Mixture No. 2, which contains more potash than No. 1, may be the more suitable mixture. In this regard it should be remembered that the phosphate and potash requirement of a sugar-cane soil can be fairly accurately determined by chemical analysis. Therefore, any grower who is in doubt as to which fertilizer to apply to any particular block is strongly urged to take advantage of the free soil-testing service provided by the Bureau of Sugar Experiment Stations.

The sulphate of ammonia requirement is similar to that recommended for the alluvial and schist soils.

REFERENCES.

[1] Bates, G., 1934. "Some Notes on the Soils of the North Queensland Sugar Areas." Proc. Q.S.S.C.T. 1934, p. 259.

[2] Kerr, H. W., 1937. "Review of Results from Fertility Trials in North Queensland." Proc. Q.S.S.C.T. 1937, p. 163.

[3] King, N. J., 1937. "Cane Soils of North Queensland." Proc. Q.S.S.C.T. 1937, p. 223.

[4] von Stieglitz, C. R., 1946. "Soil Fertility Surveys with Particular Reference to the Garradunga Area in North Queensland." Proc. Q.S.S.C.T. 1946, p. 127.

Sugar Experiment Stations Advisory Board.

The Sugar Experiment Stations Advisory Board met in the office of the Minister for Agriculture and Stock (the Hon. H. H. Collins) on Monday, 18th August, 1947. The full Board was present, consisting of the Minister (as Chairman), Messrs. J. W. Inverarity and J. C. Collier (Millers' representatives), W. L. Poustie and L. G. Scotney (Growers' representatives), and E. R. Behne (Director, Sugar Experiment Stations).

The most important recommendation made by the Board was that an area of land, already selected, be purchased by the Government for the establishment of a sugar experiment station in the Lower Burdekin district. The necessity for an experiment station in this area has long been recognized, and now that a suitable site has been found there appears to be no reason why the special requirements of the district in this regard should not be fulfilled in the near future.

Prior to the war the Sugar Experiment Stations, with the cooperation of Gatton College and the tractor firms, organized Tractor Schools for young cane farmers. These Schools greatly assisted growers in the maintenance of farm equipment and the Board considered that such Schools should be revived at the earliest opportunity.

In dealing with staff matters the Board expressed dissatisfaction with the delay in the appointment of a Plant Breeder to the staff of the Bureau. The breeding of canes with specific agricultural properties and disease resistant qualities is a matter of vital concern to the industry, and the hope was expressed that immediate action would be taken by the Government to have this important position filled without further delay.

In commenting on the field days held at Meringa and Mackay Sugar Experiment Stations earlier this year, the Board expressed its satisfaction with the manner in which these functions had been conducted. They felt that their action in recommending the revival of the field days was amply justified.

Several other formal matters in connection with the operation of Cane Pest and Disease Control Boards were dealt with.

A New Type of Fertilizer Spreader.*

By G. Camuglia.

THE fertilizer spreader to be described was designed specifically for the purpose of distributing sulphate of ammonia, but it may be used successfully with all common types of fertilizer.

In the design of this machine it was considered that the following features were essential:—

(*a*) The machine must be narrow enough to pass freely between the rows of cane, even when the crop was comparatively well developed;

(*b*) It must be light enough to make haulage easy;

(*c*) It must be strong enough to carry a reasonable quantity of fertilizer and to crush the hard lumps which occur in sulphate of ammonia;

(*d*) It must have as few moving parts as possible. The feeding device must be made of a material capable of resisting the chemical and physical action of the fertilizer and must be easy to clean.

Of these requirements the last was the most difficult to fulfil. A trial was made with a hardwood roller but this wore too quickly under the abrasive action of the material. Finally, a cast-iron roller was found suitable.

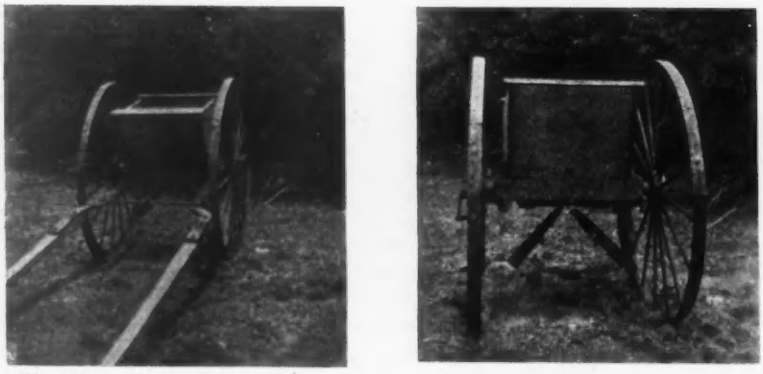


Fig. 10.—Two views of the fertilizer spreader.

The implement is illustrated in Fig. 10. It will be seen to consist of a simple carriage, 35 inches wide, on which rests a wooden hopper capable of holding one bag of fertilizer. At the bottom of this hopper is a cast-iron roller, four inches in diameter, in which are cut four helical grooves, each $\frac{5}{8}$ inch deep. The roller forms a rigid portion of the axle of the carriage. The wheels run free on the axle or may be locked to the axle by means of a manually operated pawl. When the pawl is engaged the roller rotates with the wheels.

* Paper presented at the Innisfail Conference, Q.S.S.C.T., May, 1947.

Beneath the roller lies a flat cast-iron plate with a slot, ½ inch wide, parallel to the axis of the roller. A second plate sliding underneath this plate has its edge cut to a *V* shape, so that by advancing or withdrawing the lower plate, less or more of the slot is uncovered. The sliding plate may be locked in position by means of a bolt and wing nut. The adjustment provided enables the rate of application of fertilizer to be set within the range of one-half bag to four or more bags per acre. The stream of fertilizer emerging from the slot is divided and directed to two points of application by two sloping chutes, visible in the illustrations.

When drawn by a horse this spreader is capable of treating 14 to 16 acres per day—the operator riding on the carriage. The implement could be attached to a narrow tractor, in which case it could treat 20 acres per day. Provision is made for other implements to be attached to the rear of the spreader.

Ratooning of Drought and Frost Stricken Cane. Bundaberg-Childers District.

By S. O. Skinner.

BECAUSE of the destruction to cane caused by drought and frosts in the Bundaberg, Childers, and Gin Gin areas during the abnormally bad year of 1946, many unusual practices were forced upon growers in efforts to re-establish their farms for a 1947 harvest. Not the least important was the adoption of unusual ratooning methods to meet the circumstance of having an unmillable standing crop to handle.

In the Childers area particularly, cane, mainly of the variety P.O.J.2878, which was to be cut as eighteen months to two-year old stands, had reached a potential yield of up to 35 tons per acre by the early autumn, but the harsh conditions later reduced it to a stage where the cane was mostly dead and little or none was fit for harvest. Similar death of cane in younger and smaller crops was also caused over a wide area. This widespread devastation raised the urgent question of whether the stools would re-shoot or not if ratooned. However, conditions of such severity had not occurred for some time, and experience with the varieties now commonly planted could not help generally with the answer. The alternative to ratooning was rapid replanting.

Replanting was by no means a desirable alternative because of the great expense and difficulty entailed in the handling of the old crop, in soil preparation, in the planting itself, in other factors, such as the cost and acute shortage of planting material consequent to the widespread death of cane, and in the complete disorganisation of the annual plant and ratoon farming routine. Further, the elimination of a fallow and the limited tillage of the soil were regarded widely as poor farming practices from which probably only second class crops would result. However, it was inadvisable to risk doubtful ratooning with subsequent crop failure, and early destruction of fields began. In many cases it was hoped that with a fast and vigorous growing variety such as C.P.29/116, the replanted crops would be advanced in growth sufficiently for the following harvest. Later in the year, however, some growers with their fields still standing found that stools were commencing to re-shoot. This gave impetus to ratooning.

The second question arose then, of how to handle the old crop most economically to favour successful re-growth. As would be expected, methods employed varied greatly, but they may be summarized as follows:—

(1) Cutting down the old crop and carting it off, or stacking it in row interspaces at convenient intervals. Normal ratooning operations were then followed.

(2) Rolling and burning the crop or *vice versa*.

(3) Burning and knocking down the crop with a rail. In one instance a length of portable tramline dragged crosswise in both directions gave excellent destruction of the stand.

(4) Burning only without any cutting, rolling, or knocking down.

(5) By allowing the crop, provided some foliage was still green, to remain and volunteer as a standover.

Fig. 11.—Illustrating poor recovery of stools and weak growth, where no cultivation was given following burning of the old crop.

The first three methods gave excellent re-shooting, and, where the old crop residue allowed adequate cultivation, the ratoon crops which have developed are as good as those which might be expected from stools ratooned in a normal year. With heavy crops, the first method ensured cleanliness of the field for tillage. With smaller crops of up to five feet of cane, however, the second and third methods presented no trouble and have proved extremely successful. Initial tillage was done mainly by disc implements.

The fourth method, that of burning only, hindered cultivation, and growth suffered accordingly (Fig. 11). However, where cultivation was reasonably easy or was carried out without a great deal of difficulty, very

satisfactory ratoons have resulted (Fig. 12). No great difficulties are anticipated from the old stalks at harvest. It is expected that the majority will burn or be in a well-rotted state, and will thus offer little hindrance.

With the first four methods, any life which may have remained in the old stalks was killed when the useless crop was burnt. Ratoon shoots consequently came away as vigorous base growth from the stool itself.

Fig. 12.—A vigorous ratoon stand where field was burnt but not rolled. Inter-row cultivation was given and many of the old stalks have fallen down. The dead stalk displayed indicates size of old crop.

The fifth method, that of leaving a crop, where the sticks and foliage showed some life, to remain untouched and volunteer as stand-over, proved, in the main, a failure. Many stalks shot at the eyes and produced a bunch of weak, useless growth, while good base suckering was hindered and made little progress. Furthermore, a prolific growth of summer grass soon took control (Fig. 13). With this method it was very noticeable in numerous instances that stools failed to recover and completely died out.

The soil type of the areas where these unusual ratooning methods were used was mainly of the red volcanic class. Useful storm rains which fell towards the end of the year were, no doubt, important in stimulating re-growth of cane stools.

In summing up the disastrous 1946 season, it is felt that several valuable lessons have been learnt, which should prove of great assistance in the event of a district experiencing a similar unfavourable year. Firstly, "while there is life, there is hope," and the possibilities of ratooning a cane crop, apparently dead from frost and drought, should be considered very carefully before ploughing it out. Secondly, in the

handling of the unmillable cane before ratooning, the more expensive method of cutting and carting off or stacking the dead crop is entirely unnecessary, provided that a more simple method can be adopted which will allow cultivation.

In the Bundaberg, Childers, and Gin Gin areas, it is widely accepted that many acres were destroyed unnecessarily last season. In one mill area alone it is estimated that some 650 acres were hurriedly and expensively ploughed out and replanted, while many more were either turned under, grazed, or left standing for later destruction, when they could have been simply and profitably ratooned.

Fig. 13.—Death of entire stools; poor growth, weak re-suckering and the solid mat of grass are evident in this field, which was left to volunteer as a standover crop.

Of the five methods which were employed to handle the dead crop to allow continuance of the stand, it is considered that burning combined with rolling or knocking down the dead crop with a rail provided the cheapest and best means, particularly with the smaller to average sized crops. Subsequent cultivation of the ratoons so treated was carried out with comparative ease.

In one instance a light, apparently dead, first ratoon stand showing a possible yield of less than 10 tons per acre was rolled and burnt to facilitate ploughing out. Promising re-shooting, however, altered the original intention and it was decided to ratoon the field. Initial tilling was done by disc cultivation and on present indications the field will cut within the vicinity of 25 tons per acre as second ratoons. This remarkable recovery amply illustrates the success which can be achieved from ratooning frost- and drought-affected crops even where the original appearance of the cane suggests it is lifeless.

Methods of Dealing with Dead Cane Crops.*

By Norman J. King.

Introduction.

THE severe drought and killing frosts of 1946 in the Bundaberg and Isis districts resulted in one unusual problem for the growers of those areas. Large acreages of cane, unfit for milling by virtue of the fact that the crops were quite dead, had to be destroyed in some fashion without having to resort to cutting down the crop and carting it off the field.

Sugar cane, however, is a remarkably hardy crop and many of the fields under discussion would, no doubt, have survived the dry conditions had not killing frosts in June, July, and August overcome the lowered resistance of the plant. In the Bundaberg area no less than thirty frosts were recorded and grass readings reached the extraordinary low figure for this district of 24°F. Complete death supervened in many of these crops as evidenced later by their inability to ratoon.

The problem then arose as to the most suitable method of disposal of these crops. The time factor was rather important as the land had to be made income-producing without delay. In some extreme cases every acre of land on the property had to be prepared for replanting. At the same time some of the growers desired to take advantage of the large body of dead trash, tops, and stalks available by incorporating them into the soil. There were, therefore, two principal methods of treating the dead crops—(*a*) Dealing with the unburnt material; and (*b*) Dealing with the material after burning.

Disposal of Unburnt Crops.

It is only natural that any problem submitted to a number of individuals should be tackled in a number of different ways and this was no exception. The methods used were governed to some extent by the implements and power at the grower's disposal, and also by the individual's idea as to the method of handling the job. Where the grower decided to make full use of the dead material as a soil amendment three methods were employed to ensure the desired result:

(1) Rotary heavy crops down and plough in;

(2) Rotary light crops down and rotary in second time over;

(3) Rotary crop down, drill in interspaces and replant.

Where a heavy crop was rotaried down, the stalks, tops, and trash were chopped up into a mass of dry material, most of which was left on the surface. This was no easy task as some of these crops were in the neighbourhood of 40 tons per acre of standover cane. The chopped-up residue was sometimes knee-deep on the field. Such a mass of material is almost beyond the capacity of any plough, and several growers considered the problem insoluble at this stage and put a fire into the chopped-up crop. One grower, however, devised an ingenious method of turning under the material with a two-disc plough plus a spinner. It was found that the plough alone choked up so rapidly with trash that a satisfactory job could not be performed. He altered the geared

* Paper presented at the Innisfail Conference, Q.S.S.C.T., May, 1947.

drive on a spinner so that it threw to the right instead of to the left and thus raked the trash into the plough furrow. By alteration of the draw bar the spinner was attached behind the plough. A double furrow width was then cleared of trash and as the plough turned this

Fig. 14.—Illustrating a field of dead cane.

Fig. 15.—Appearance of a field of dead cane after it had been treated with a rotary hoe.

strip over, the spinner raked the next furrow width clean, depositing the trash in the open furrow. By this means an excellent ploughing job was performed and very little trash or cane was visible on the surface at the completion of the operation. Figs. 15 and 16 illustrate the field before and after this ploughing.

In the second method of dealing with unburnt crops two rotary hoeings were carried out. These crops were mostly light—from five to

12 tons per acre—and the first hoeing chopped up the crop and incorporated a fair percentage of it with the surface soil. The second time over the rotary hoe was able to cut deeper and a good admixture resulted.

The third method was used by only a few growers where plant crops had died. It was considered imperative in these cases to get the land replanted as soon as possible. The crops treated were in the neighbourhood of 10 tons per acre. The grower rotaried the cane

Fig. 16.—A view of the same field as in Fig. 15, showing the effect of a disc plough and spinner after the rotary hoe.

Fig. 17.—View of a cane field showing the results obtained by treating the crop with a rotary hoe and making new drills in the old interspaces.

row with a three-feet width of blades just deep enough to ensure dislodging the stool and at the same time leaving all residues on the surface. Without any further preparation the interspaces were drilled out and the cane replanted. The replanted field is illustrated in Fig. 17 which shows clearly the new drills and the line of plant residues where the old crop was grown.

Disposal of Burnt Crops.

In the majority of cases, however, the grower elected to burn the standing crop prior to using any implement for destruction of the crop. Many such farmers would have preferred to retain all the organic material for soil improvement but considered that decomposition in the soil would take too long and delay replanting. Their decision was, therefore, influenced by their desire to replant as soon as practicable without risking further prolonged delays brought about by a possible extension of the prevailing dry conditions. They argued, no doubt rightly, that dead stalks in the soil would not form so many air spaces as a large body of trash and tops, and, in the event of suitable rains, planting would be possible earlier than on land where trash also had been turned in.

Fig. 18.—Illustrating a field where the crop was burnt and then rotaried.

The pre-burning methods can also be divided into four sections, brought about once again by individual ideas on the subject and by the availability of suitable implements. The various methods used were—

(1) Pre-burning followed by ploughing in the standing crop;

(2) Pre-burning, rotarying, and grubbing;

(3) Pre-burning, rolling, and rotarying;

(4) Minor variations of the above.

The first method requires no explanation. After burning, the fields carried a standing crop of dead or semi-dead stalks. The tractor-drawn plough knocked these down and covered them more or less effectively. The final result was rather rough and untidy.

In the second method a rotary hoe was used instead of a plough to deal with the burnt crop. This was more effective in incorporating the material intimately with the soil and in breaking up the base of the stool. It resulted in leaving a fair proportion of the cut-up stalks on the surface as shown in Fig. 18 and these would need ploughing under at a later date to ensure decomposition. If, however, the rotary

operation were followed by grubbing—as it was in many cases—the short stalks would not be a serious obstacle and they could remain on the surface and slowly decompose there after the cane crop was planted.

Three photographs, Figs. 19, 20, and 21, illustrate the excellent preparatory work performed by the method of pre-burning, rolling, and rotarying. Practically no residue of stalks remained on the surface

Fig. 19.—Illustrating a crop burnt prior to rolling down.

Fig. 20.—The crop shown in Fig. 19 after rolling down.

and the land was left in good condition for the growth of a green manure crop or even for cane planting if a couple of deep grubbings followed later. The dead crops did not roll down too well: the old stalks were fibrous and tough and did not snap off at ground level

as would succulent cane, but the recumbent position allowed better cutting with the rotary blades, particularly if the latter were kept sharp.

Minor variations of the above methods were tried out more or less successfully on several other farms. Disc harrows and bush and bog implements were used on small crops, but the principal obstacle to their success was the tough and fibrous nature of these dead crops. Discs, even carrying considerable weights, would ride over the stalks instead of cutting them and would, not infrequently, choke up in front with the body of loose dry material.

Fig. 21.—The field shown in Figs. 19 and 20 after treatment with the rotary hoe.

Discussion.

All dry farming practices are in the nature of a gamble on the future weather. A method which turns out unsuccessfully this year owing to the unsuitable climatic conditions may be crowned with success next year due to fortuitous circumstances. The lack of suitable soil moisture to encourage rapid decomposition of crop residues could conceivably continue for several months and result in much delayed planting. Consequently the value of such methods as described above can be discussed only from the angle of an average season.

It is well known that the crop residues of sugar cane, the tops and trash, are deficient in nitrogen, and that the stalks contain even less. A study of averages of many analyses of tops and trash and of millable cane indicates that while the cane contains 0.044 per cent. of nitrogen the tops and trash contain 0.176 per cent.—four times that in the stalks. Even when the soil is moist and the temperature high the factor which limits rapid decomposition of trash and tops is nitrogen. The bacteria and fungi which carry on the decomposition require nitrogen for their own bodies. If this is not available in sufficient quantity from the material being decomposed then the decomposition slows down. By the same reasoning the decomposition of the cane stalk should be even less rapid because of its lower nitrogen content, and the denser nature of the material possibly obstructs the speed of

rotting. This would explain why odd stalks of cane left on a block always remain longer than the leaves and tops. It has been shown [1] that plant residues should contain not less than 1.7 per cent. of nitrogen to enable micro-organisms to bring about active decomposition without any additional nitrogen being required from outside sources. It is obvious, therefore, that neither the cane stalks nor the tops and trash will decompose rapidly and that during the rotting the surrounding soil will be robbed of its available nitrogen supply.

There are two ways of overcoming this nitrogen shortage and thus accelerating the decomposition process. One is to apply sulphate of ammonia broadcast on the block and the other to grow and then turn in a green manure crop. This crop will supply an amount of nitrogen sufficient to assist in rotting down a heavy cane crop and the nitrogen later becomes available for the succeeding planting. Where sulphate of ammonia is used it is probably better to broadcast this prior to turning the crop in. If applied afterwards rain is necessary to wash it into the soil before it can be of use.

While recognizing the probable value which would accrue from incorporating the trash and tops with the soil, the writer is of the opinion that this practice defeated its object in this particular case. The individual grower desired, because of his severe loss, to get the land back into cane with the least possible delay. The principal planting period in this area is December to February. To achieve rotting of crop residues in a maximum of three months he would require ample soil moisture and nitrogen. So far as the writer is aware, nitrogen (as sulphate of ammonia) was not applied to any of these blocks and time did not permit of growing a leguminous crop. It would appear unlikely, therefore, that decomposition will proceed vigorously or that planting with cane will be effected in the anticipated period. Where the trash, tops, and stalks were rotaried in the chances of rotting are better than where ploughed in. Rotarying brings about a more intimate admixture with the soil and each fragment is in contact with soil particles and with soil moisture. Where a heavy body of dry material is ploughed under, a layer of trash, tops, and stalks exist with a layer of soil on top of it. Large air spaces must allow rapid drying out with consequent slowing down of decomposition. If the material is not decomposed rapidly the next ploughing will bring it all to the surface again.

It would appear that the most expeditious method of destroying the dead crops and getting the land back into cane was the pre-burning method. This procedure allowed the grower to work on the dead stalks free of the major obstacle of a large body of trash. Of the methods used for dealing with the stalks only, probably the best was rolling and rotarying. By this means the chopped-up cane was mixed into the soil, not in a solid layer, but fairly well distributed to a depth of 6 inches. The ploughing-in of the burnt crop resulted in the line of stools being knocked down by the tractor and then turned under as stool units. These would impede subsequent work by cross ploughing or grubbing, and on the whole, delay farm operations.

Conclusion.

The investigation of these methods of dealing with dead crops on a large scale was a most interesting one. Much ingenuity was displayed by the growers in overcoming a new problem at short notice,

and it is possible that these methods may be of use to farmers in other parts of the State when called upon to deal with crops killed by flood, grubs, or rats. This report deals only with the preliminary work done and it is planned to follow up all these methods so that the success or failure of each may be assessed.

REFERENCES.

[1] Waksman, S. A.: 1936. "Humus" p. 123.

The Consolidation of Soil in Drills after Planting Sugar Cane in Northern Queensland.

By G. Bates.

THE practice of consolidating the soil in the furrow after planting cane is a very old one, but in the Cairns district, until recently, was usually adopted during dry weather only. It was commonly carried out by a chain, roller, log of wood, or bag of soil which was dragged behind the planter; in other cases where consolidation was treated as a separate operation a log of wood or heavy flat board was dragged over after planting.

With the advent of cutter-planters it was found, that many of them, because of incorrect setting or inherent mechanical faults, did not place the plant firmly in the soil. Moreover, preparation of dry land

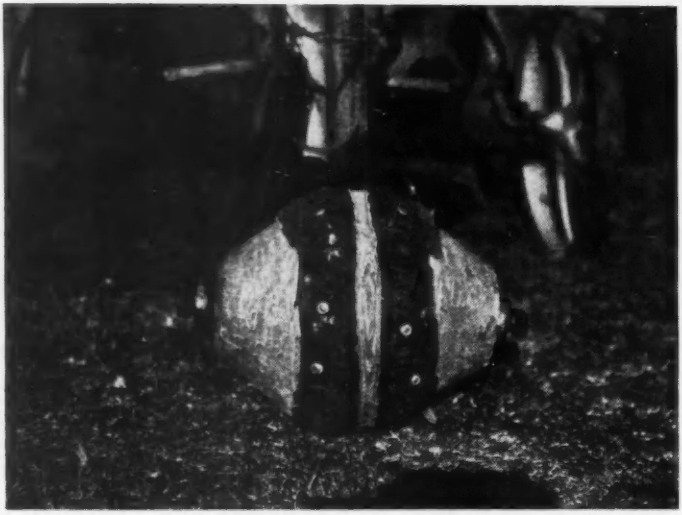


Fig. 22.—Wooden roller shaped to fit in furrow and shod with an old tyre cover to decrease accumulation of mud; dragged behind planter for consolidation of soil over plants.

frequently left the soil in lumpy tilth at planting time. Air spaces formed by lumps falling around the plant caused rapid drying out of the soil, and poor germination followed. During dry planting seasons this fault was accentuated. In the old days of cane holing, experience showed that it was necessary to press the plant firmly into the soil and tramp the soil on top of the plant to ensure a good strike (a practice still in use when planting supplies), but most modern cutter-planters are not designed to consolidate the soil over planted setts.

No trouble was encountered where there was adequate soil moisture and the soil was in good tilth, but when the soil moisture was low or the soil somewhat lumpy then germination difficulties followed. Growers experimented with consolidation of the soil after planting and proved its value under certain soil conditions. The method most widely used at present is to drive a light rubber-tyred tractor over the planted drills. This can be done very quickly and the ordinary tractor weight is not too heavy unless the soil happens to be very moist, in which case consolidation would not be necessary and would not be desirable. A more recent development is to drag a chain behind each tractor wheel, the idea being that the tractor wheels press the soil round the plant and the chain drags some loose soil into the drill, thus preventing caking of the consolidated surface. Moreover, it has been found that in drills that are rolled, young weed seedlings germinate quickly unless a light covering of soil is placed on the compressed surface. The farm utility or lorry is sometimes used instead of the tractor for consolidation.

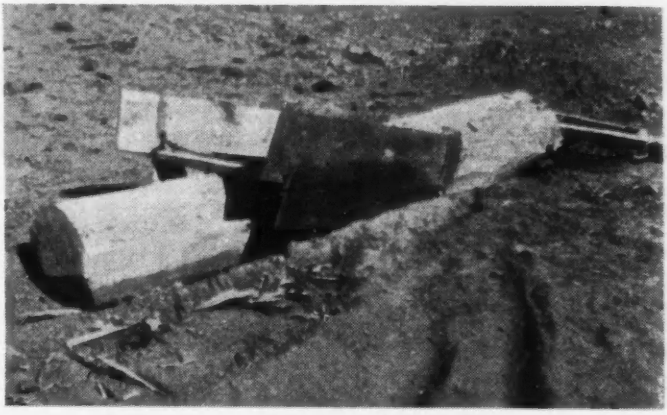


Fig. 23.—Log of wood, shaped to a blunt point in front, with fins attached, which is drawn along planted drills to consolidate soil over setts.

In the case where growers drag a chain, a bag of soil, or a roller behind the planter, some difficulty is experienced at the ends of the rows if there is any backing to be done with the machines, and an extra man to manipulate the consolidating unit may be required. A weakness of these gadgets is that for the most part they are not heavy enough.

An implement was designed many years ago for use in a separate operation after planting. It consists of a log of wood with fins attached and is drawn along the drills, the log consolidating the soil and the

fins throwing out into the interspace any lumps that may be present. It is known sometimes as a "pig" (Fig. 23). A more primitive method is the dragging by a horse of a hardwood board approximately 5 feet long, 1 foot wide, and 2 inches thick over the planted drills with the driver standing on the back portion of the board to give weight. To prevent excessive digging into the furrow sides, the front part of the board is shaped into a blunt point.

Fig. 24.—Small concrete roller encased in a metal cylinder dragged behind the cutter-planter, commonly used in the Burdekin. The roller is not shaped to fit the furrow and is too light for cloddy fields.

Fig. 25.—A short length of a split log dragged behind a cutter-planter to press soil over setts; used by a Burdekin cane grower.

A question arises as to whether or not consolidation can be too heavy, but observation suggests that, with the exception of the tractor, most other means of soil packing in common use are on the light side for dry, lumpy soils. Even light packing of wet soils, however, may be harmful and should be avoided because compaction on most moist soils may press the soil so tightly around the setts, and also leave a hard crust on the surface, that germination is decreased rather than improved.

We have a record of one block of alluvial land in Babinda that had no less than four different packings. Firstly, the bottom of the drill was pressed hard by the wheels of a 3-ton lorry which was loaded with cane for stick planting. Then the rubber-tyred tractor wheels passed over the bare cane, dragging a couple of scarifiers to cover two rows at once. After covering, the tractor was twice run over the drills to pack the surface because the weather remained dry. There was a perfect strike in this case, where soil moisture was considered inadequate for a good strike under normal planting conditions, the variety being Badila.

Trials conducted some years ago by the Bureau showed that compacting the surface soil definitely raised the temperature of the soil surrounding the plant by some two to three degrees. Even in the absence of other effects, this temperature increase in itself would be sufficient to hasten germination.

Fig. 26.—Appearance of furrows after consolidation of soil over setts with split log attachment behind cutter-planter, showing smooth compressed bottom of furrows; a sandy loam soil in the Lower Burdekin.

Notes on Beetle Collections in the Mulgrave Area, 1946-47 Season.*

By P. Volp.

During 1946, damage caused by the greyback grub was the heaviest in the Mulgrave area since 1933, and indications pointed to heavy flights of this beetle during the latter end of the year or early 1947. Approximately 3,000 acres of cane were affected, the infestation ranging from an average of one grub per stool to 14 grubs per stool (February, March diggings, 1946).

Growers affected by this pest were concerned at the rapid increase in population and, since owing to adverse soil conditions fumigation was not practicable on a large scale in 1946, the collection of beetles was adopted by the Mulgrave Cane Pest and Disease Control Board as a possible means of control. Instead of appointing receivers in the various

* Paper to the Pest Boards' Conference, held at Innisfail, 8th May, 1947.

sections of the area, a central depot for collecting was selected, with the Board's Supervisor the sole receiver. The price of beetles was fixed at 1s. 6d. per lb. One factor which operated unfavourably in beetle-collecting campaigns in past years was the malpractice of certain collectors who adopted various means of defrauding the pest funds. In this campaign, such practices were at a minimum and in only two instances were attempts to defraud detected. These were promptly dealt with.

Climatic conditions play an important part in the life cycle of the beetles. As only 626 points of rain, spread over 39 wet days, fell in the grub-affected area from 2nd March to the end of December, the general opinion of growers was that the beetles could not survive such harsh conditions. Contrary to these expectations two flights of beetles took place, one in late December and early January, and the other in early February. In 1945 the main flight of beetles occurred during the last week of December, whilst minor flights took place in January.

During the period of the first flight, 2,219 lb. of beetles were received and in the second flight, 4,668 lb.—a total of 6,887 lb. Counts of beetles made from those delivered showed that in the first flight males predominated to the extent of 60 per cent. of the total, whilst in the February flight the figures were reversed. The emergence took place in the loose, friable, volcanic and schist soils following light showers, the heaviest recording at that period being 65 points and the lowest 15 points. In all, 338 points of rain, spread over 17 days, was recorded during December and January. During the first week of February 1,380 points were recorded, thus soil conditions were then favourable for a final emergence. The majority of females in the first flight became egg-laden but, owing to dry and hot soil conditions, heavy mortality took place whilst the beetles were attempting to re-enter the soil. (Countless numbers of egg-laden beetles were found dead, either on the surface or within two inches.) Unlike the first flight, the fertility of females in the second flight was of a low percentage. Numerous counts revealed that the percentage of egg-laden beetles ranged from 15 per cent. to 40 per cent., the latter being over the last three days on which collections were made. The greatest number of fully-developed eggs noted was 16 per beetle, whilst 10 and 12 eggs per beetle were quite common. It seems probable that this sterility, or appreciably reduced fertility, was caused by the delay in emergence due to dry soil conditions.

In past years growers had planted weeping fig-trees on headlands or in horse paddocks, &c., with the object of facilitating the trapping of beetles by luring them to a strong light. Only a very small percentage of the beetles received were caught by this method, owing to bright moonlight nights prevailing throughout the flighting period. Collectors mainly concentrated their efforts on these trees during the early daylight hours. An afternoon survey of the district during the flight period showed that these easily accessible trees were practically cleared of beetles whilst other feeding trees such as Moreton Bay ash, bloodwood, and wattle in adjacent forest country carried a large population. In this campaign the indications are that the collectors mainly confined their attentions to trees bordering cane fields. At the same time, the fact cannot be overlooked that these more accessible trees were collected from each morning throughout the beetle-flighting period with approximately the same daily catch. This may indicate that during the

redistribution which takes place at early morning flight, many of the beetles from the trees from which beetles were not collected re-settled on the accessible trees and thus were collected eventually. If this happened there would be a daily diminution in the beetle population of the non-collected trees. On the other hand, if the beetles collected from the same trees each day represented mainly specimens which issued from the ground on the previous night, then it is reasonable to suppose that the population in the less accessible trees would possibly increase rather than diminish.

The collection of beetles has been a subject of discussion whenever a meeting takes place between growers who are troubled by this pest; whilst some are favourably disposed towards beetle collecting, others are opposed to this method of control. In this paper data have been recorded which may be used possibly by growers in their arguments for or against the adoption of collection as a means of control.

At 220 beetles to the pound, the beetles received during the period of the two flights amounted to approximately 1,514,000. Since the area infested with grubs in 1946 was 3,000 acres, and allowing for the emergence of an average of even one beetle per stool from this infested area, the number of beetles which flew would be in the vicinity of 15,000,000 (computed at 5,000 stools per acre). The weight of such a number approximates 30 tons, and as roughly three tons of beetles were received, the latter figure would represent only a relatively small percentage of the possible total emergence. Climatic conditions adversely affected the development of the grub during its progress to the beetle stage, delayed emergence of the beetle to a later period, and also probably prevented the successful hatching of eggs. It would seem that under the conditions of extreme and prolonged drought during 1946 and early 1947, Nature has taken a big part in the control of the beetle pest. At the time of writing no figures are available as to the infestation of fields, following the favourable soil conditions subsequent to the heavy February flight, but it is hoped to have this data available for the Conference.

Effects of Dry Weather on the Greyback Beetle.*

By J. H. Buzacott.

FREQUENTLY the expression is heard among farmers during a dry year that should the weather remain dry until Christmas there will be no beetle flight. Whilst it is customary for cane beetles to fly in all parts of North Queensland prior to Christmas, it is certainly not a fact that the beetles will fail to emerge if there is insufficient rain before Christmas to assist emergence.

In most years a fall of one-and-a-half to two inches of rain, sufficient to release the beetles, occurs some time during late October, November or December. However, in many areas there was practically no rain during the latter months of 1946, and consequently it was interesting to observe exactly what would happen when sufficient rain fell at some period after Christmas.

* Paper to the Pest Boards' Conference, held at Innisfail, 8th May, 1947.

The northern portion of the Gordonvale district probably experienced the most extended drought during 1946 of any of the northern cane growing districts, and the remarks which follow refer mainly to that district. The rainfall in the northern portion of that area for the 11 months ended 4th February, 1947, was only 815 points. No rainfall great enough to release beetles fell during the 1946-47 summer months until 4th February, when some five inches were recorded. During early 1946 the grub infestation in the Mulgrave area was heavy and widespread, so that with normal weather there should have been a large emergence during the normal flighting period for the area, i.e. November or December. When the drought continued until February there was a great deal of surmise regarding the possibilities of all the beetles having perished underground. With the advent of the February rain a fairly heavy flight occurred and some three tons of beetles were collected almost entirely from the northern portion. However, although the flight was heavy whilst it lasted, it was finished within comparatively few days.

It is a very difficult matter to assess the relative size of flights in different years. Some guide may be given possibly by comparing amounts collected. It should be stressed, however, that if the years compared are distant, the amount of beetles collected will often be determined by the relative accessibility of feeding trees in the two periods. The evidence shows that whilst only three tons of beetles altogether were collected at Mulgrave during January and February, 1947, no less than 22 tons were collected during the year 1914. The year 1914 was selected for comparison, as bonuses for collecting beetles were not paid in the Mulgrave area between the years 1917 and 1946; it was therefore necessary for comparison purposes to go right back to 1914 to obtain a year of widespread grub infestation when collections were made. Even allowing for certain malpractices which may have been rife during the larger collection, it still remains a very much higher figure. In 1914 a comparatively normal, primary emergence took place on 5th December. This is some indication then that with the very late emergence of 1946-47 there may have been quite a large mortality in the soil.

During the period of waiting for beetle flights from December to February, continual evidence was brought to hand of dead beetles being ploughed up, and although it is not uncommon to find a certain number of dead beetles in the soil during any hot, dry year, it seems certain that there were more than usual during this past season. Admitting that there was a fairly high mortality among beetles waiting to emerge, it is believed that an even higher one might have taken place had the weather been less dry during the winter and spring months when pupation was about to take place. Grubs tend to pupate at a depth where there is sufficient moisture to form a cement-like cell. In this cell the pupae remain relatively unaffected by surface changes of temperature or by fairly wide variations in moisture content of the surface soil. During 1946, those grubs which went down to pupate during the usual winter period penetrated sufficiently deep to escape the main variations of weather. However, due to the late flight of the previous year and to the generally unfavourable feeding conditions during the different grub stages, many grubs were still feeding in August and September. Most of these appear to have pupated at a fairly shallow level, probably due to the fact that the soil was too dry and hard for them to penetrate

below plough depth. It is believed that these late pupating grubs changed to beetles which largely perished through drying out. The weather during the early part of the year, or at least during the spring months, may, therefore, have a profound effect on the ultimate fate of the beetle. Extensive diggings during December, 1934, showed that over 40 per cent. of pupae and beetles were dead in their cells. In addition a number of parasite cocoons were found. Naturally the longer the period which elapses before emergence the greater will be the number of larvae or pupae destroyed by predators and parasites.

For many years now we have held the view that probably the major cause of a complete "wipe-out" of cane grubs in any area was the effect of unfavourable weather during the egg-laying period. The eggs are definitely more susceptible to desiccation than any other stage of the insects, but since they are laid at a period which coincides usually with heavy rains it is not often that the peculiar conditions necessary to inhibit egg-hatching occur. During a year like 1946, probably the greatest effect on the subsequent population was caused by a combination of the effects of dry weather on the grub, pupal, and beetle stages. For instance, in addition to the mortality among these three stages, an examination of beetles captured from the February, 1947, flight indicated that comparatively few females developed eggs, and of those which did, only about half the normal number were produced. Beetles from the February flight should have experienced ideal conditions for egg laying and subsequent hatching, because rainfall during the remainder of February was well distributed.

With regard to the effect of drought on grubs, it has been indicated that during years when a normal wet season is experienced, the grubs pupate at such a depth that although losses occur due to a later drought or a dry summer, they are probably insufficient normally to influence greatly the subsequent infestation. On the other hand, when the period of emergence is delayed because of dry weather till after Christmas, these losses may be sufficient to have a profound effect. However, from 1914 till the present time only twice, viz., during 1919-20 and 1946-47 have the beetles in the Meringa area (which usually has the latest flight of any of the northern cane districts), emerged in quantity after Christmas, although a small local emergence at Aloomba was recorded during 1928 when beetles emerged and fed on the block of cane from which they issued.

The actual distribution of grubs following the late emergence of 1946-47 will not be determinable for some time. In addition to the effect of drought on egg production of the beetles which flew, there is the fact that the Mulgrave Cane Pest and Disease Control Board paid for beetles and large numbers were collected. It will, therefore, be difficult to determine how much reduction of grub population has been effected by dry weather and how much by collection. However, it is already obvious from diggings that there is some survival of grubs in the areas where collections were made. Furthermore, in spite of the long, dry period and deferred emergence the wipe-out has not been nearly as complete as that experienced at the end of 1934.

Without producing a paper of undue length, the full effect of drought on beetle emergence can only be briefly discussed. The main object, therefore, of this paper is to place on record facts concerning what is believed to be the latest greyback beetle flight yet observed in the sugar areas.

Caterpillar Outbreak at Ingham.

By J. H. Buzacott.

During April, 1947, cane crops in the Ingham district suffered severe defoliation (Fig. 27) as the result of a large-scale attack by caterpillars of a grass moth.* These caterpillars are fairly common each year in the sugar-growing districts, but have not been observed to damage cane very often. Generally they confine their feeding to grasses but on occasions, usually at long intervals, the pest breeds rapidly and an invasion of sugar cane by the caterpillars may then follow. Outbreaks on a scale large enough to cause injury to cane were reported in the Mulgrave Mill area in 1916, 1926, and 1946. These, together with the 1947 outbreak at Ingham, constitute the total number of occasions on which the caterpillars have been recorded in plague proportions. As a matter of interest, it is recorded that a related species† of caterpillar caused the complete defoliation of a crop of giant cowpea in the Gordonvale district during 1936.

Fig. 27.—Typical damage to cane in a weedy field by caterpillars of a grass moth.

* *Mocis frugalis* Fab. Noctuidae.
† *Mocis trifasciata* Steph. Noctuidae.

The adult moth (Fig. 28D), specimens of which very commonly fly to lights at night, is greyish-brown with a well-marked streak of darker colour running diagonally across the forewings. The average width across the outstretched wings is approximately one and a half inches. The moth lays its small eggs on grass and the tiny caterpillars which emerge from the eggs feed on the grass and develop to a length of approximately one and three-quarter inches. The caterpillars migrate to cane in search of fresh food after the grass is eaten out or has become unpalatable. The general colour of the caterpillar is variable but the commonest colour is pale creamy fawn and it moves over the grass and cane with a looping motion. Frequently the caterpillars remain motionless for a considerable period with the front half of the body projecting at an angle to the leaf (Fig. 28A).

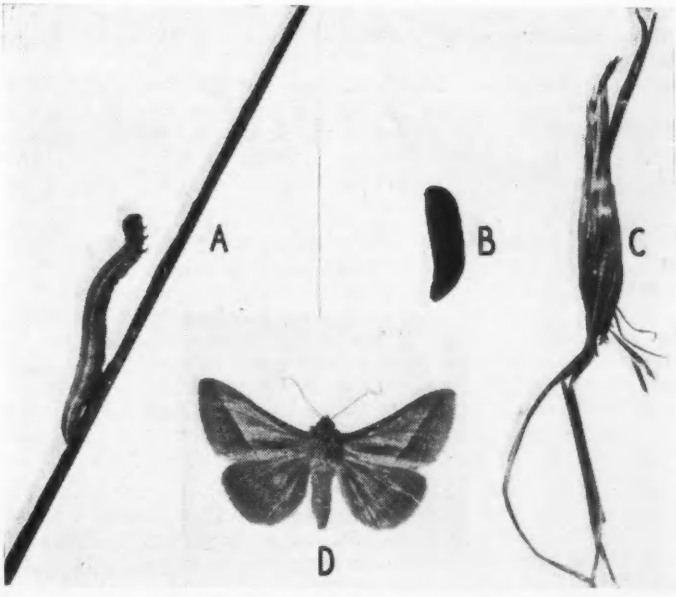


Fig. 28.—Stages in the life cycle of a grass moth. *A*. Caterpillar; *B*. pupa or chrysalis; *C*. grassy cocoon enclosing pupa; *D*. adult moth.

When the caterpillar is full grown it forms a pupa (Fig. 28B) within a tube consisting of pieces of grass which are glued together (Fig. 28C). In fields of sugar cane the pupa is often found in a tube at the tip of a cane leaf, formed by joining the edges of the leaf together. The pupa is approximately three-quarters of an inch long, light-brown in colour, and covered with a powdery bluish white bloom. After a resting period the moth emerges from the pupa and so the life cycle commences again.

The 1947 outbreak at Ingham is the largest which has been recorded in Queensland cane districts. Caterpillars were first observed in the fields late in March, and early in April they were distributed throughout the district. It was estimated that well over 1,000 acres of sugar cane was defoliated to some extent. In a great proportion of this area

the cane was stripped to the mid-rib. Serious stripping was practically confined to blocks of cane in the 10 tons per acre class or less and in nearly every instance there was a great deal of grass in the fields. It is almost certain that the moths were in the first instance attracted by the grass and laid their eggs there. The foliage of this grass was mainly eaten before the caterpillars commenced feeding on the cane.

Several species of grasses were attacked, but, among the cane rows, awnless barnyard grass* and crowsfoot grass† were the dominant grasses. However, in several places outside the cane paddocks the caterpillars were observed feeding on Para grass‡ whilst in some instances couch grass§ also was attacked. Canefields were attacked in most parts of both Victoria and Macknade mill areas. The worst defoliation observed was at Gairloch, Fairford, Forest Home and Trebonne, but caterpillars were also plentiful round Halifax and towards the Stone River.

In most instances Trojan was the variety damaged, but since Trojan is the major variety in the Ingham area this fact is without much significance. However, due to the rather poor cover in light crops of Trojan, grass growth was worse in fields of this variety and was probably a contributing factor in the choice of such fields for egg laying by the moths.

Although the damage was very spectacular, particularly in those blocks in which nothing but the mid-ribs of the cane was left, it is considered that the actual losses in cane yields will not be great. Cane possesses great powers of recovery, and a month or so after defoliation of a crop a complete new set of leaves normally appears. Since in no instance was the growing point of the cane observed to be injured, recovery of a considerable portion of the damaged crop at Ingham was anticipated. However, at harvest, the lack of trash in caterpillar-infested fields may cause some poor burns and make harvesting a more difficult job.

Anxiety was felt by some farmers that a second generation of caterpillars would follow the first with serious results However, examination during April showed that large numbers of the caterpillars had succumbed, due either to cold nights or to disease. In addition, many caterpillars and pupae were parasitised, and several species of flies and wasps known to be parasitic on the caterpillars were observed in operation. By the end of May there was very little evidence, except on the oldest leaves and in those blocks which arrowed, that the cane had ever been attacked. In the latter case the cane presented a rather bare appearance since with the arrow formation no further leaves were produced.

In view of the many insect parasites and predators actively attacking the caterpillars it was not considered necessary to advise control measures. As it happened in most instances, by the time control measures could have been adopted, the caterpillars were already past their peak and little good would have been achieved.

---

* *Echinochloa colonum.*

† *Eleusine indica.*

‡ *Brachiaria mutica.*

§ *Cynodon dactylon.*

Mites which Attack Sugar Cane.*

By J. H. Buzacott.

At least three species of the tiny eight-legged animals known as mites attack sugar cane in Australia. They are seldom observed without a close search because of their almost microscopic size; indeed, the largest of the three species is only just visible to the naked eye. The damage which they cause, however, is much more apparent than the mites themselves.

Probably the first record of mites attacking sugar cane in Queensland was in 1879 when a serious outbreak of what was then called "rust" occurred. It was found that the rusty appearance was caused by the feeding of a countless number of tiny *Tarsonemus* mites. Since that time there have been a few occasions when the damage was great enough to attract attention, but generally it is slight and remedial measures are not warranted.

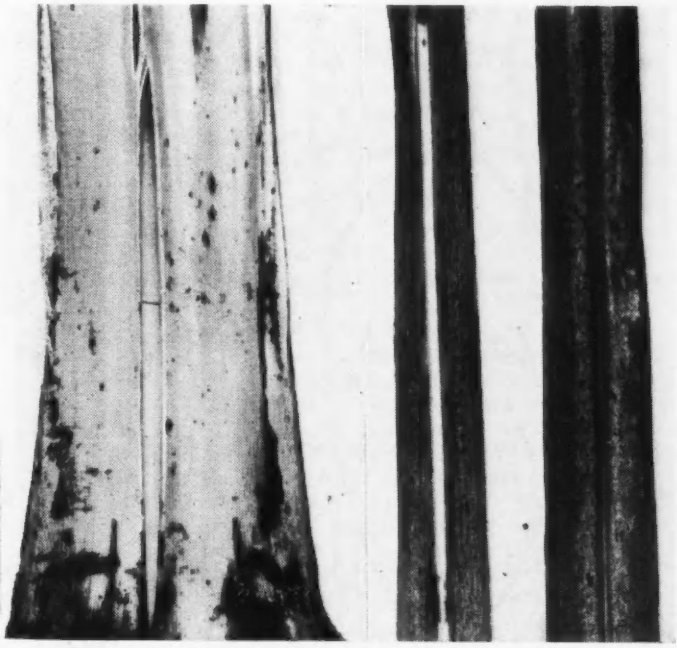


Fig. 29.—Damage to leaf sheath by *Tarsonemus* mite (left); damage by *Tetranychus* mite (right).

The principal interest in mites from the field supervisors' or farmers' point of view is the resemblance which mite damage bears to some rather more serious fungal diseases of sugar cane. In particular, an infestation of the leaf mite known as *Tetranychus* is frequently

* Paper to the Pest Boards' Conference, held at Innisfail, 8th May, 1947.

mistaken for an outbreak of downy mildew disease. Not only does the mite cause rusty stripes through the leaf blade but the gossamer-like web that the animal spins on the underside of the leaf completes the resemblance to downy mildew.

The Leaf Mite.

A species of *Tetranychus*, the leaf mite, is widespread in Queensland and damage by it is frequently noticeable in the drier months of the year. Usually its presence is indicated by the appearance of pale or rusty longitudinal bands in the cane leaves. In earlier stages a series

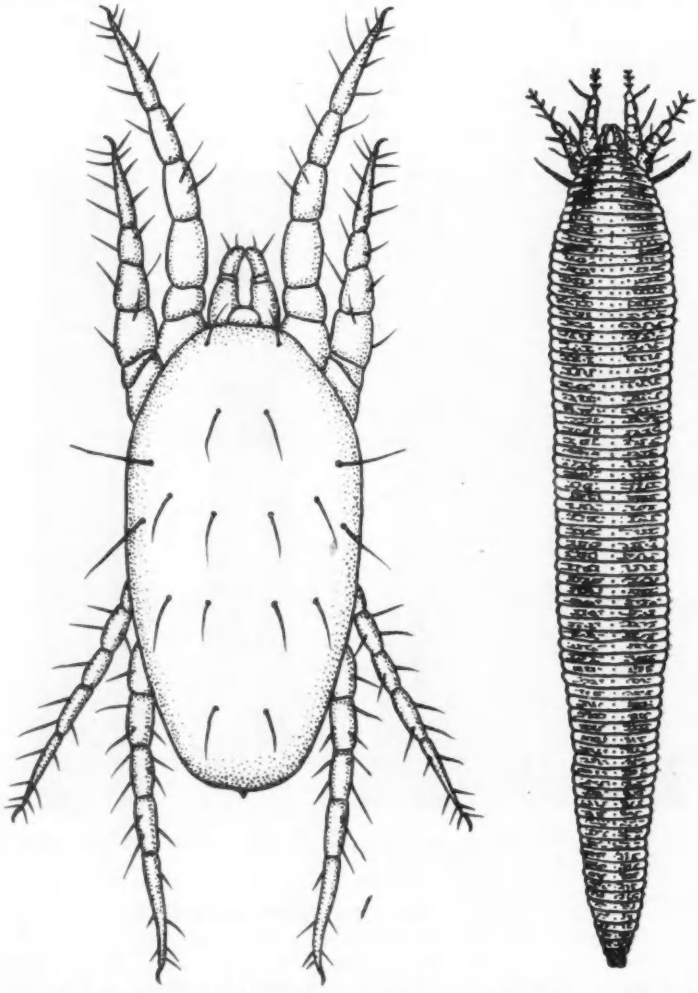


Fig. 30.—*Tetranychus* mite, female on left; *Eriophyid* mite on right. Both highly magnified.

of tiny pale green dots can be seen, which form a creamy coloured band on each side of the mid-rib on the underside of the leaf. Later the spots become rusty in colour (Fig. 29, right). On close examination of the leaves with a pocket lens the fine web which *Tetranychus* spins may be observed on the underside of the leaf blade. Suspended in this web are the cast skins and eggshells of the mite whilst the greenish mites in all stages can generally be seen running either under the web or on top of it. The eggs are comparatively large and translucent, varying from pale green to orange in colour and are distributed singly through the web. The young leaf mites are similar in form to the adults and there is little difference in appearance between the adult sexes except that the male is somewhat smaller than the female. Figure 30 (left) is an illustration of an adult female leaf mite and its natural size is approximately one seventy-fifth of an inch in length.

Whilst the appearance of rusty streaks renders mite damage more apparent, the animals are usually to be found in greater numbers when the damage is less obvious. *Tetranychus* mites frequently occur on the same leaves as infestations of sugar-cane aphis, but they do not secrete honey-dew and are not the cause of the black fungus or sooty mould which frequently follows an aphis infestation.

Damage by the leaf mite is generally confined to a rusty colouration of the leaves, more marked on the underside, and consisting of numerous very small red spots surrounding the punctures caused by the feeding of the mites. Leaf mite damage is often evident when conditions are hot and dry and usually the damage is more spectacular than actual. Evidence of feeding disappears when good growth is brought about by heavy rains and no control steps are necessary. The mites seem to prefer varieties with rather hard leaves. Trojan appears to be the most favoured in far North Queensland at the present time, although considerable populations have also been observed on several seedling canes and also on C.P.29/116.

The Stalk Mite.

This mite belongs to a genus called *Tarsonemus*, and it does not spin a web. Although it was the species stated to be responsible for the "rust" outbreak of 1879, it rarely appears to attack cane leaves. Generally it is confined to the stalk and feeds under the leaf sheath either on the stalk or on the inner side of the leaf sheath itself. Characteristically the damage to the cane stalk from the stalk mite appears as a rusty streak in the region of the bud groove. In more severe infestations the rusty appearance may spread round the stalk, whilst in some instances it is only possible to find the damage on the inner surface of the leaf sheath. Figure 29 (left) illustrates the scattered rusty spots which follow the feeding of these mites on a leaf sheath.

Stalk mites are quite different in shape from leaf mites and in this group the male (Fig. 31, left) and female (Fig. 31, right) are also markedly different. Like the leaf mites they are very minute and a full-grown female measures only a little more than one hundredth of an inch in length. They are very pale coloured and almost translucent, and in consequence it is difficult to find them even with a lens. Stalk mites, like leaf mites, appear to favour certain varieties and sometimes seedling canes show appreciable marks of their feeding. They have not been noticed to any extent in present commercial varieties. In Hawaii it was found in past years that D.1135 was susceptible to damage and Badila resistant.

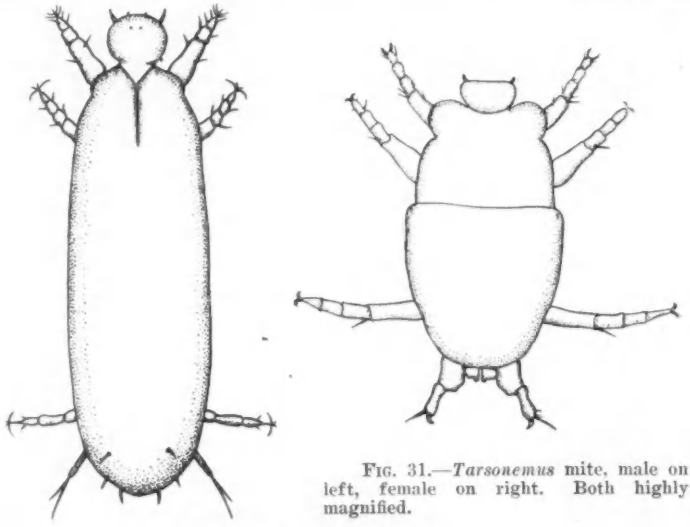


Fig. 31.—*Tarsonemus* mite, male on left, female on right. Both highly magnified.

The Eriophyid Mite.

This is the most minute of the three types of mite known to attack sugar cane in Queensland, and it is only about one one-hundred-and seventy-fifth of an inch in length (Fig. 30, right). There is only one record of its appearance; it was located in the Bundaberg district in 1944 where it was associated with mottled and stunted shoots of P.O.J.2878. Little is known about the species and reference to it is made here only in order to make the list complete. A peculiarity of the Eriophyids is that individuals are provided with two pairs of legs only, which are situated right at the anterior portion of the body. Mites belonging to this group are frequently referred to as rust mites because many species cause rusty discolourations on their food plants.

Cultures for the Inoculation of Green Manure Crops.

The growth of leguminous green manure crops is increased if the seed is first inoculated with the correct strain of nitrogen-fixing bacteria. These bacteria form nodules on the roots of legumes and are able to fix the nitrogen from the atmosphere, and make it available to the plant. This not only produces a better legume crop, but provides a valuable supply of nitrogenous matter for the succeeding cane crop.

Since 1938 the Bureau has been supplying cane growers with cultures of nitrogen-fixing bacteria for the inoculation of their legume seeds, and on an average there have been between 2,000 and 3,000 acres of inoculated seed planted each year.

Applications for cultures should be made to "The Director, Bureau of Sugar Experiment Stations, Brisbane," at least a fortnight before the proposed planting date, and should state the type of legume to be planted, the quantity of seed, and the approximate date of planting. A nominal charge of one shilling is made for the service, and this amount should be forwarded with applications.

D.R.L.S.

The Soil Factor in the Selection of Varieties under Mackay Conditions.

By W. A. McDougall.

The Varietal Position at Mackay.

FROM the point of view of numbers, the Mackay district has at times appeared as a veritable "variety garden." Even as recently as the past 10 years the following non-approved canes, which were better known in the earlier history of cane growing, have been encountered during inspections to enforce varietal regulations:—B.147, B.208, Black Tanna, Brisbane Seedling, Cheribon, E.K.1, E.K.2, H.109, H.Q.409, H.Q.458, Korpi, Malabar, Malagache, M.189 (Black Innes), Nanemo, N.G.16, N.G.22 (Mahona), N.G.24 (Goru or Farmers' Glory), N.G.24A, N.G.42 (Palmyra), N.G.66, Otamite, Q.855, Q.1092, Q.1098, Rose Bamboo, S.J.3, S.J.4, S.J.16, S.J.28, S.C.12/4, Striped Garnham, Striped Singapore, Uba, White Bamboo, and 7R.428 (Pompey). Other canes which have appeared for a short time in recent years and then later have been eliminated include P.O.J.213, P.O.J.234, Co.210, Co.213, Co.281, and Jason. Q.20 and Oramboo were also deleted from the 1946 lists of approved varieties.

Because of the number of varieties under cultivation when the "approved variety" concept was introduced, it has been necessary to make changes gradually and at the present time, despite the elimination of many varieties, the lists of approved varieties for the Mackay mill areas are among the largest in the State. Nevertheless in 1944-45-46, with the exception of one area, 90 per cent. of the total crop was yielded by six varieties—namely, Q.28, E.K.28, M.1900 Seedling, Co.290, P.O.J.2878, and H.Q.426. Of the minor approved canes, H.Q.285 (Milton) exists in one area only, P.O.J.2714 is confined to one locality, while Q.813 and S.J.2 are disappearing. D.1135 is grown in very small tonnages on shingle and in a few fields subject to grub infestation. Comus and Q.45 are new canes and have not yet attained widespread popularity. P.O.J.2725, which displays a high degree of grub resistance when harvested before mid-season, is on the increase. Although this variety is not favoured because of early recumbent growth and early arrowing, it has good features to recommend it as a minor variety. Sugar content is high; it is the best striker of the P.O.J. varieties and under reasonable conditions gives good results when planted early.

The Large Approved Variety Lists at Mackay.

In examining why the approved variety lists are comparatively long, although only six varieties produce the bulk of the crop, several reasons are apparent.

Firstly, the eagerness of some farmers to grow new varieties tempts them to give any new cane a trial on their farms in the often unwarranted hope that it may be a success on their particular piece of soil. Fortunately, this desire does not activate the great majority or farmers who, in the main, confine their efforts to the growing or four or at most five varieties which have proved themselves by repeated trials to be all that is required commercially to cover early, mid-season, and late harvesting needs.

Secondly, the variability of the Mackay climate, soils, and growing conditions generally tends to create a demand for a number of different varieties. For instance, a variety which shows up well in a good season may give only a mediocre performance in other less favourable seasons. A similar situation exists in other groups of mill areas but to a smaller extent than at Mackay.

Thirdly, the lists tend to remain large because the Mackay mill areas cover a wide territory and farmers are loth to discard varieties until they have been tried for some time. The true value of a cane is arrived at only after usage over a number of years, so that generally speaking there are always a number of varieties under trial commercially. In the Mackay district more or less useless varieties tend to be retained unduly. This may be due to an occasional good yield under favourable local conditions or to a farmer's personal fancy. Actually in many cases, however, economic results are often more imaginary than real.

Fig. 32.—Irrigated plant crop of M.1900 Seedling on grey sandy forest soil at Mackay.

Unless varieties are of general merit they are seldom grown extensively and "special purpose" canes are not favoured. In some years, usually when the sugar content of all canes is abnormally low, requests for early maturers are widespread. But up to the present no cane has lasted or has been used extensively merely because it was an early maturer. For example, H.Q.285 (Milton) has the virtue that it holds a fairly high sugar content for about a month early in the season but it is a relatively poor cropper, hence it has not been grown to any great extent. Similarly, Q.20 has a very high sugar content and is consequently well above average at the commencement of crushing, but a brittle eye, shy striking and bad growth habits are serious agricultural defects which made the cane unpopular and caused its

removal from the approved lists. On the other hand, H.Q.426 (Clark's Seedling) has remained in use as an early maturer for many years because in addition to the fact that it has early high sugar which holds for most of the harvesting period it has general agricultural qualities of a fairly high standard. Thus it is an excellent striker, fair ratooner, and gives reasonable yields. In other words, it is a cane which, depending on what canes are available on the approved variety list, may be and has been used as the bulk crop on farms.

Fig. 33.—Field of irrigated plant crop of Q.28 on grey sandy soil at Mackay.

Varietal Requirements for the Mackay District.

In seeking to improve the varietal position in the Mackay district the objectives are canes which can be used widely on particular soil types and give reasonable yields under the varying conditions which will be encountered over a number of years. In the broad approach to the problem it is necessary to separate the Mackay soils into two main types; sub-types, particularly those on forest country, are not of primary importance. The main types are:—

1. Forest soils:
   (*a*) Flat, light coloured soils, a foot or less in depth with a clay sub-soil; often associated with drainage problems.
   (*b*) More fertile types than (*a*), often on undulating country.
2. Scrub soils:
   Originally covered by rain forest, much of it river bank alluvial. They may be divided into sub-types based on soil depth and substrata. Further division may be made on the basis of fertility now largely an effect of the time under cultivation with cane.

The table below indicates the approved canes at present most valuable to the Mackay mill areas, having due regard for soil type and plant cane maturity. For maturity purposes it can be considered that

Soils.	Early Varieties.	Mid-season Varieties.	Late Varieties.
Forest	H.Q. 426	Co. 290 .. .. M. 1900 .. .. Q. 28	E.K. 28 P.O.J. 2878
Scrub	H.Q. 426	P.O.J. 2725 .. Badila	Q. 45 E.K. 28 P.O.J. 2878

the ratoons of all varieties precede by one class those of the respective plant crops. For example, the ratoons of Q.28 and P.O.J.2725 often yield fair sugar at the commencement of an average season and could thus be classed as early varieties in the ratoon crops. It will be noted that the table shows that only three of the nine canes listed can be used on both major soil types with a reasonable expectancy of satisfactory results.

The mid-season canes provide the bulk of the crop. For many years previously M.1900 and Badila (N.G.15) were the chief varieties of the Mackay crop but, as the table in Fig. 34 indicates, Q.28 has now become the major cane of the district, the larger portion of which is forest country. With the decline in Badila plantings because of greyback grub damage and decreasing fertility in scrub soils which have grown cane for many years, P.O.J.2878, a late maturing cane, highly susceptible to downy mildew disease but fairly resistant to grub attacks under reasonable growing conditions, has become the best variety available for the main crop on scrub soils. P.O.J.2878 has tended to displace H.Q.426 also on these soils, because the latter is highly susceptible to grub attack.

A new Bureau Seedling, Q.50, originally selected at the Mackay Experiment Station, Tekowai, has been rapidly propagated in recent years and was added to the 1947 approved variety lists. Like Q.28 this variety is a mid-season plant cane for forest soil but with its higher sugar content it may prove a serious competitor to Q.28.

The policy of selecting and propagating such varieties as Q.28 and Q.50 for the forest soils has been highly successful but the selection of a mid-season cane for scrub soils in the Mackay mill areas still remains a real problem. The variety P.O.J.2878 is the standard to be surpassed if the present artificial control measures for cane grubs are not improved. While the grub problem remains on scrub soils careful consideration must be given in selection to the grub resistance of varieties.

The varieties Comus and Trojan are not suited, in the main, to forest lands at Mackay but may be of some use on the scrub soils. Comus is an excellent striker and has good sugar content at mid-season but will not withstand grubs or moderate climatic checks and is an unreliable ratooner. Trojan, like P.O.J.2878, is a late maturer and apparently needs fertile soil and fair to good growing conditions. Its degree of grub resistance under Mackay conditions is not yet known and cannot be estimated until its reaction over a number of years has been studied.

Mill.	1945 Season.				1946 Season.				1947 Season.
	Percentage of Q.28 of Mill Harvest.		Tonnage of Q.28 Harvested.	Average C.C.S. of Q.28.	Percentage of Q.28 of Mill Harvest.		Tonnage of Q.28 Harvested.	Average C.C.S. of Q.28.	Estimated Percentage of Mill Area Growing Q.28.
	Area.	Tonnage.			Area.	Tonnage.			
Plane Creek	*	19·9	26,926	13·2 (·4 below mill average)	*	28·2	44,365	13·50 (·9 above mill average)	More than in 1946
Racecourse	22·7	37·4	46,209	Slightly above mill average	37·2	47·4	85,059	12·6 (slightly above mill average)	60·0
Pleystowe	26·0	32·9	50,905	12·9 (·8 below mill average)	*	41·52	69,336	13·5 (about mill average)	*
Marian	19·0	26·4	39,914	13·9	*	41·60	57,047	13·87 (·5 above mill average)	More than in 1946
North Eton	28·6	37·0	24,149	13·7 (·3 below mill average)	54·0	48·0	43,564	12·1 (about mill average)	55·0
Cattle Creek	14·0	22·6	18,766	14·2 (·7 below mill average)	*	31·09	20,012	13·7 (·8 above mill average)	Less than in 1946
Farleigh	30·0	38·7	68,073	13·1 (·7 below mill average)	45·0	47·8	78,256	14·0 (·3 above mill average)	55·0
Proserpine	8·0	11·2	17,906	14·7 (·7 below mill average)	21·0	26·3	25,774	13·65 (·65 above mill average)	30·0

* Figures not available.

Fig. 34.

The Need for Carrying Out Selection of Varieties on Scrub Soil at Mackay.

It is clear that varietal improvements for forest soils under Mackay conditions have out-stripped those for the more fertile scrub soils. Improvements in cane varieties may be brought about in two ways—namely, (*a*) by breeding and selecting under local conditions—or (*b*) by introducing varieties from other sugar-growing districts or countries.

The two Bureau seedlings, Q.28 and Q.50, which have proved outstandingly successful on forest soils at Mackay, were selected on the poor forest soil of the new Mackay Experiment Station, Tekowai.

Fig. 35.—Field of non-irrigated plant crop of Q.28 at Mackay, stripped ready for cutting plants.

However, up to the present, no variety of comparable merit suitable for the more fertile scrub soils has been selected at this Station. The only Bureau variety which has been selected at Mackay and which has shown some promise for the scrub soils is Q.45. This was originally selected, however, on the alluvial soil of the old Mackay Experiment Station, The Lagoons, where it was well ahead of the standard of those days—namely, Q.813, which actually is essentially a forest cane. Field observations in recent years show that Q.45 is not suitable for forest soils and on the more fertile soils is not as good as P.O.J.2878, and like the latter is a late maturer.

Evidence suggests that the site of the original seedling selection and of early observation of a seedling's performance is most important in deciding the soil type most suitable for it. When a selected seedling has been taken off the Experiment Station, the field trials with it give information on its behaviour on different soil types as well as on soils similar to that on which it was selected. But in the long run, experience

Fig. 36.—Field of non-irrigated plant crop of Q50 on second class alluvial soil at Mackay. Stalks stripped ready for cutting into plants.

Fig. 37.—Irrigated plant crop of Q.45 on alluvial soil at Mackay.

has shown that such field trials seldom give more practical information than that already obtained by observation on its performance on the soil of the original selection.

The Bureau seedling, Q.28, which has proved so eminently useful for forest soils of low fertility at Mackay is not favoured on the more fertile soils for two main reasons. Firstly, under good growing conditions Q.28 makes rank growth on fertile soils and the tangled, sprawled stalks present a difficulty in harvesting and C.C.S. may be low. Secondly, the more fertile soils are usually deep, well drained and more susceptible to drought, while Q.28 prefers a comparatively shallow soil with a stiff clay subsoil.

The introduction of varieties for Mackay mill areas is a process continually being carried on under the supervision of Bureau officers, but success in this direction is limited by the fact that introduced varieties have to contend with differences between local conditions and those under which they were bred. In the past, many introduced canes have been sorted out at Mackay by numerous field trials and a similar procedure will continue in future. In addition, the Sugar Experiment Station in recent years has acted as a very effective and time-saving sieve for forest canes. Introduced varieties which, over a number of years, have failed to make the grade on the Station itself are unlikely to be of much use for forest soils of the district. Actually it has been noted in tests, on more than one occasion, that well-known canes brought from other districts have failed to perform on the poor forest soil of the Experiment Station as well as locally bred seedlings which themselves have been discarded because of their inferiority to the Q.28 standard.

The New Seedling Sub-Station.

The difficulty in selecting at the Experiment Station, seedlings suitable for the better class soils of Mackay, has been recognized for some time and the Bureau has decided to secure the use of an area of fertile scrub soil on which seedlings can be selected for this purpose. A site has been chosen on a farm on Lansdowne Road and approximately 1,800 seedlings will be set out this year. The original seedlings will comprise seed from crosses which are deemed to be most likely to give satisfactory results on the fertile soils of Mackay, and in selecting canes the need for a mid-season cane for the bulk of the crop on scrub soils will be a primary objective.

The Introduction of Badila into Queensland.

By C. G. Hughes.

ALTHOUGH this article happens to appear at a time when the percentage tonnage of Badila is decreasing it is certainly not an *in memoriam* notice, for there is still a future ahead of this fine variety and it will be many years before it is displaced from its position as the leading cane of the State. It is common knowledge that Badila came originally from a native garden in New Guinea, being brought back by the expedition led by the late Mr. Henry Tryon, but, as far as the present writer is aware, details of the trip have never been published. They have been brought to light recently during an attempt to reduce the enormous piles of correspondence which had accumulated in the Department of Agriculture and Stock building, William Street, Brisbane, during the past fifty years or more. Most details of the expedition are there, together with the distribution and behaviour of the varieties when grown at Mackay and Kamerunga (near Cairns). Many of the letters are in the beautifully uniform handwriting of the copying clerks but a proportion are typewritten in a type not seen on modern machines, and others again are in the honest, laboured hand of men apparently more used to working than to writing. The idiosyncrasies of personalities and the oddities of Government administration are displayed in candid fashion but time has so smoothed them out that they are now seen to play only a small part in the story of the expedition.

The original intention of Mr. Peter McLean, then Under Secretary of the Department of Agriculture, was to use the cutter "Lizzie Jardine," which, under the command of Captain J. Griffiths, was employed on departmental work on the Central Queensland coast. However, the Captain's report on the condition of the vessel was so unfavourable that the idea was abandoned. Indeed it is remarkable that the "Lizzie Jardine" could be used for anything seeing that "her topsides above the copper were very bad, the wood around the bolts was quite rotten and her main-boom decayed." Arrangements were then made for a boat to be chartered from Burns Philp and Company and the cutter "P.C.E.," of nineteen tons, was obtained for a period of two months at £20 per month. It was to be handed over ready for sea in all particulars excepting wood and water, provisions and crew. Captain Griffiths was to proceed to Thursday Island with two men and take command of the cutter.

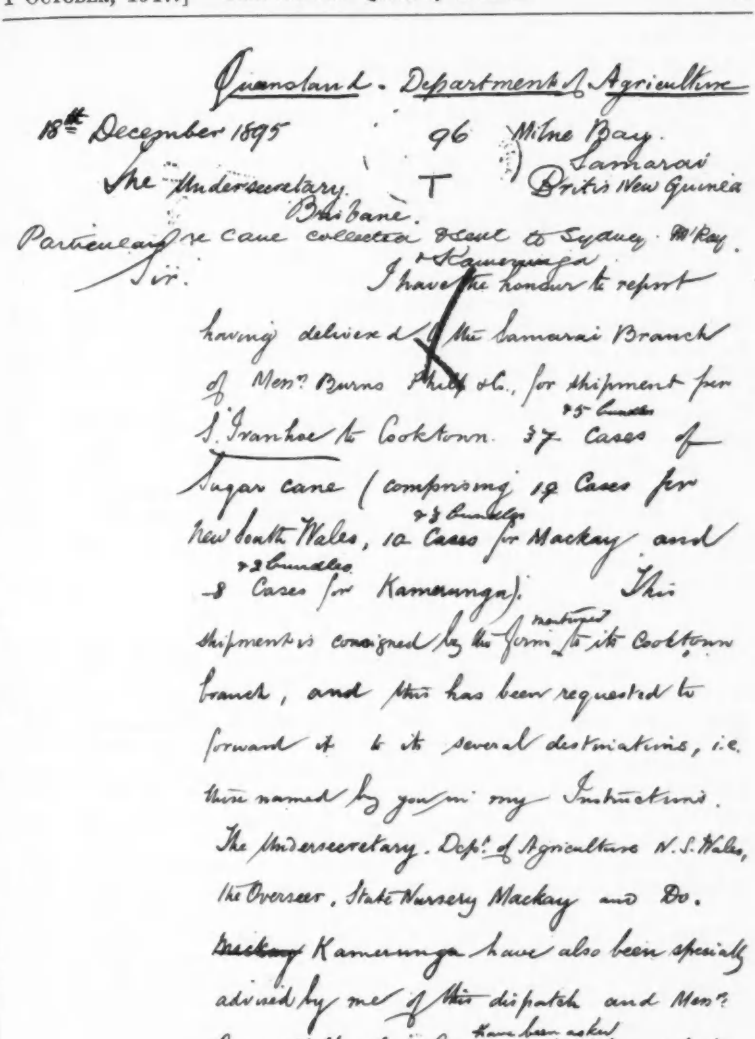
The Brisbane contingent left on s.s. "Warrego" on 26th August, 1895. It included Mr. Henry Tryon, Entomologist to the Department, John Liverseed, and Mr. R. Wilson. Mr. Tryon had been selected to lead the expedition because it was known that beetle and moth borers were present in New Guinea and an entomologist was properly considered to be more likely to obtain insect-free canes than one not so trained. John Liverseed, who later became manager of the Hermitage State Farm, was then storeman at the Department. He was put in charge of a supply of "trade" to be used for bartering with the natives. Items on his list included tobacco, matches, pipes, gilt chains (at two shillings per dozen), assorted beads (32 pounds at one shilling per pound), and some calico and twill. The medicine chest was under Mr. Tryon's

direct personal control, apparently for the reason that it contained the only alcoholic liquor allowed on board. John Liverseed was also expected to assist in the collection of canes and their packing. Although it was not expressly stated that he should do so, he also used to carry Mr. Tryon ashore from the ship's boat so that Mr. Tryon would not get his feet wet or cut on the sharp coral. Mr. R. Wilson went as a passenger, but there is little mention of his activities on the expedition. He died only eight years ago, after rising to the post of Acting Under Secretary in the Department of Agriculture and Stock.

There was some dissension in the party after arrival at Thursday Island and Captain Griffiths, who had confessed to ignorance of Torres Strait and New Guinea waters, accepted the recommendation of the Government Resident, the Hon. John Douglas, C.M.G., to resign, and returned by mail steamer to Mackay. Captain Bebrouth was given command of the cutter and she sailed from Thursday Island on 14th September, 1895.

A call was made at Port Moresby in order to meet Sir William McGregor and present a letter of introduction from Mr. McLean. However the Administrator was away at the time and the expedition left the capital on 30th September without having seen him. The next few days were spent in calling at villages along the coast to the east of Port Moresby, but no canes were collected since all were suffering from the effects of the current drought. On 9th October, Mr. Tryon called on a Mr. Guise, who lived near Hula, and in consultation with that gentleman decided to organise a special trip to the Kemp Welch River. Seven days were spent up this river and, although little cane was obtained, the trip was not without its excitements, as at one stage Mr. Tryon "was deterred from continuing his journey by reason of a threatened personal attack on the part of the inhabitants of a native village." A good deal of cane was seen but it was all either standover and riddled with boring insects or else far too young. The drought and near-famine conditions of the land were blamed for the lack of suitable canes and less than two cwt. were obtained. Varieties taken included some collected by E. Cowley in 1893, samples of which Mr. Tryon had brought with him in order to avoid undue duplication. This batch of cane never reached Queensland as it was later discarded owing to inability to ship it.

After leaving Kemp Welch River a severe storm was encountered and the Captain took shelter at Caution Bay, some thirty miles to the west of Port Moresby. Seas were still high when the voyage eastwards was resumed and the cutter put in at Port Moresby before going directly to Samarai on Dinner Island at the mouth of Milne Bay, where she arrived on 12th November. Mr. Tryon met Sir William McGregor at Samarai and after a long discussion Sir William proposed that Mr. Tryon should prolong his stay by about two months and, after discharging the "P.C.E.," attach himself to Sir William on the "Merrie England." This arrangement, however, was apparently not accepted. It was about this time that the Under Secretary began to get worried about the lack of canes and the mounting expenses, but several telegrams including one peremptory demand to return at once, did not reach "your obedient servant, Henry Tryon, Entomologist," until he had been back in Brisbane for some time.



Queensland. Department of Agriculture

18th December 1895 96 Milne Bay.
Samarai
British New Guinea

The Undersecretary. T
Brisbane.

Particulars re cane collected & sent to Sydney per Mikado.

Sir. I have the honour to report having delivered at the Samarai Branch of Messrs Burns Philp & Co., for shipment per S. Iranhoe to Cooktown 37 Cases of Sugar cane (comprising 19 Cases per New South Wales, 10 Cases for Mackay and 8 Cases for Kamaranga). This shipment is consigned by the firm mentioned to its Cooktown branch, and this has been requested to forward it to its several destinations, i.e. those named by you in my Instructions. The Undersecretary. Dept. of Agriculture N.S. Wales, the Overseer, State Nursery Mackay and Do. Kamaranga have also been specially advised by me of this dispatch and Messrs Burns Philp & Co. of Cooktown have been asked to telegraph to them and to yourself of its receipt and of their intention to effect its early transmission. ...

In utilizing this means for sending the Collection forwarded I may mention that

FIG. 38.—A facsimile of the first page of Mr. H. Tryon's covering letter referring to the consignment of cane plants from New Guinea, which included Badila.

It would appear that during the next month or so Mr. Tryon was too busy collecting canes to write any reports and the next letter from him, dated 14th December, 1895, at Milne Bay, mentions that the small amount of case timber still remaining would prevent much further sugar cane being obtained. Between 19th November and 12th December fifty apparently different varieties were secured from the country at the back of Bently Bay, and from between it and East Cape, and from that facing the entire seaboard of Milne Bay. "The obtainment has indeed been an arduous undertaking, involving on my part lengthy journeying on foot or in canoe, and my being on more than one occasion absent from the cutter for several days in succession." On 18th December, 1895, Mr. Tryon delivered to Messrs. Burns Philp and Company at Samarai 37 cases and five bundles of sugar cane collected in the Milne Bay area (see Fig. 38). A further collection was made in the Mullen's Harbour area and a number of bundles of cane brought from there.

Next news of the expedition was contained in a telegram from Cooktown announcing Mr. Tryon's arrival per "P.C.E." direct from Samarai. Apparently the Mullen's Harbour collection was aboard. The first consignment had come to Cooktown earlier on the schooner "Ellangowan" but had missed the weekly mail steamer and was still in store when the "P.C.E." arrived. With Mr. Tryon aboard and with both batches of cane the s.s. "Arawatta" sailed from Cooktown on 10th January leaving Mr. Wilson, John Liverseed, and a man named Hansen to pack surplus stores after paying off the cutter.

Meanwhile preparations had been made in Cairns to receive the batch for Kamerunga. A special train brought the two and a quarter tons from "Arawatta" to Redlynch Railway Station on the evening of Saturday, 11th January. On the following morning some of the cases and bundles were hauled to the Nursery. The first cane taken out of the first case opened showed that live borers were present. The cane was repacked and taken back to Redlynch station while Mr. Cowley awaited instructions. These were to the effect that he was to go ahead and plant the cane, which he did, cutting the sticks into small setts and carefully examining each piece. It was noted that the cane was shooting in the packing and shoots were often two to three inches long. Mr. Cowley records that the borer was seen in every variety except one, with infestation varying from "borer present" to "alive with borer." Fifty-six different varieties totalling some 2,000 setts were unpacked with No. 15, later to become widely grown as "Badila," represented by 96 setts. It had borer present and was a dark-purple, short-jointed cane. The crop from this planting was prolific, the average number of sticks was 10 and the leaves were broad and handsome; it was classified as "class 2, well in front."

The consignment for Mackay included the only complete set of the Milne Bay batch, as well as canes from Mullen's Harbour. A total of about two tons of cane was received at Mackay. Mr. D. Buchanan, the Overseer of the Nursery, reported that there was no need to be afraid of the borer in that locality (it was already there) as there was very little left of the first lot of canes after he had been through them. The lot from Mullen's Harbour was in better condition. There were fifty varieties in the first consignment, *i.e.* from Milne Bay, and thirty in the second, including a number of duplicates, from which a total of sixty-six different canes was obtained. A report in the following year stated

that one No. 15 was "not a promising cane," although the other No. 15, from Milne Bay, was "a great crop"; the difference was more an indication of soil variation as between the two plots than any difference between the two canes.

The three and a half tons of cane sent to New South Wales did not open in good condition and only 13 cwt. of germinable plants were obtained. However, the N.S.W. Government paid £71 19s. 4d. as its share of the expenses of the expedition and everybody appeared to be reasonably well satisfied.

A little over seven tons of cane had been collected by the expedition, comprising 66 named canes plus six canes regarded as variants of the named. But the expedition had been away longer than expected and had cost more than the original estimate and in his report its leader thought fit to set out in detail the reasons why he was not more successful in obtaining sugar-cane plants. He declared that he had been sent at the wrong time of the year, that all the country from the islands of Torres Strait to Mullen's Harbour had suffered a long drought and that the capacity of the cutter was also a limiting factor. It is paradoxical that one of the very few, successful, Australian plant-seeking expeditions should have had to account for not being more successful.

Leafburn, Windburn, or Sunscald in Cane.

By J. H. Buzacott.

AFTER very hot weather or a dry, windy spell, it is not uncommon to see dead areas and white patches in the leaves of young sugar cane. The appearance of affected cane bears a strong resemblance to that of cane attacked by leaf-scald disease and during the hotter months of the year, field officers are often requested by worried farmers to make an inspection of their apparently diseased fields. The leaves affected are usually one or two of the newly unfurled leaves, although in bad cases as many as five or six of the young leaves may show damage.

In spite of its serious appearance, the manifestation is not due to disease. It is simply the effect of a hot, dry period, often only a day or two in duration, on growing cane. Whilst the effect is practically immediate, the early damage is not noticed, and the symptoms do not become obvious for a few days. This visible effect on the cane is usually called "sunscald," "windburn," or "sunburn." (Fig. 39.) In the Philippine Islands and Hawaii a similar condition is referred to as *leafburn*. This latter term seems the most appropriate name as it has been amply demonstrated by Atherton Lee in Hawaii that the condition is caused by the too rapid evaporation of moisture from the cane leaves. Such evaporation may be induced either by hot winds or the hot sun. In addition, a predisposition of the cane plant to *leafburn* is brought about by the application of nitrogenous fertilizers. Some varieties are more susceptible to damage from *leafburn* than others. In North Queensland, Q.44, S.J.4, and Eros may be badly affected, whilst in the Central Districts, Q.28 and Q.50 are somewhat susceptible. Most of the varieties grown in the Southern Districts appear to be resistant, although, as indicated later, new seedlings are frequently damaged.

Fig. 39.—General appearance of a stool of cane badly affected with leafburn.

The importance of the condition is not due to its effect on the cane, because it seldom causes any material damage, but rather to the fact that it may be confused with an attack of leaf-scald disease, particularly with varieties such as Q.44 and S.J.4, which are both susceptible to

Fig. 40.—Severely affected leaves showing white streaks and dead tissue.

leaf scald. To farmers who have been warned to watch for leaf scald in these two varieties, the sudden appearance of *leafburn* through a block of cane may cause alarm. However, even in very bad outbreaks of *leafburn* where there is some temporary stunting of the cane due to the destruction of the leaf tissue, usually there are no appreciable losses at harvest. In the production of new cane varieties, some seedlings are found to suffer so seriously that they are eliminated on account of this fault and are not released for commercial production.

The symptoms of *leafburn* generally consist of broad, dead streaks up to the full width of the blade in one or more of the newly unfurled leaves. In an earlier stage the affected areas are visible as dull, greyish green patches which occur on leaves close to the spindle. In a few days the dull patches die, become ashen, and finally assume a tan colour. In some varieties, in addition to the dead streaks, there also appear white blotches and streaks on the leaves (Fig. 40) and in a few instances odd white pencil lines may be observed which strongly resemble those found in plants affected with leaf scald. In *leafburn*, however, these pencil lines do not pass down the leaf sheath as they do in leaf scald, nor can they generally be seen on the back of the leaf.

The most obvious feature of *leafburn* symptoms is that the same leaf on each affected stool will show the symptoms since every stool in a particular block has been affected at the same time. In addition, the scalded leaves have a scraggy look and flop about in all directions, whereas leaves of cane affected with leaf scald have a tendency to grow erect and curl inwards. These remarks apply to *leafburn* when it first becomes obvious. After a week or two the dead tissue assumes a shrivelled, rather mildewed appearance, whilst the furled spindle appears to be quite healthy. The older leaves of the cane are seldom affected.

One or two days when the temperature is near the 100 degree F. mark will almost invariably cause a lot of *leafburn* in susceptible varieties, particularly if the high temperatures succeed a period of cloudy weather, and are accompanied by drying breezes. Cane plants in normal growth throw off the scalded leaves and unless conditions are such as to damage the cane again, the symptoms will disappear as the affected leaves are shed. Some degree of control might be attained by an alteration of the period at which nitrogenous fertilizers are applied, but the possible gain from such a practice, however, would probably be more than offset by the loss through not applying these fertilizers at the best time.

Horse Ailments.

LAMENESS CAUSED BY AFFECTIONS OF THE FOOT.

By R. D. Chester, Government Veterinary Surgeon.

LAMENESS of this nature may be divided into three types according to the particular factors responsible for the symptoms. These are as follows:—

(1) Hereditary diseases of the bone,

(2) Diseases of the foot,

(3) Wounds and injuries.

The treatment adopted will depend on the type of lameness with which the farmer has to deal.

It is important, therefore, that an accurate diagnosis of the cause of the infirmity should be made at the outset. With this end in view it is necessary first to ascertain which leg is lame, then to locate the affection in the region of the foot. This having been done with reasonable accuracy, a thorough examination of the foot should be made.

Visual Examination.—Visual examination is made for unevenness in growth, swellings, and variations from conformation of the corresponding foot on the other leg.

Palpation.—Apply fingers and palm of hand to the wall of the foot. By this means the temperature of the foot can be judged and swelling about the coronet can be noted. The examination should be made with the horse's weight on the foot.

Percussion.—The foot should be tapped with a small hammer. Smart, heavy taps are made over the wall of the sole. The horse will flinch when the affected area is tapped. Should there be any doubt about the horse's reaction, the corresponding foot on the other side should be percussed for comparison.

Compression.—Using a pair of large shoeing pincers press on the wall of the sole of the hoof. When the inflamed area is squeezed the horse will show resentment by drawing the foot away.

Paring.—When the inflamed area is located, pare away the wall or sole to locate the actual seat of the trouble. This will also afford drainage for pus and discharges.

HEREDITARY DISEASES.

There are two important diseases of this type which are frequently seen in farm horses in Queensland. They are ringbone and sidebone.

Animals suffering from either of these diseases must be carefully handled if they are to remain useful for their normal span of life. All work on hard roads must be avoided, and even under farm conditions it is better to use an animal, affected with either of these diseases, for short spells of work rather than to put him to long hours of steady, tiring work. There is no treatment for either of these conditions.

Ringbone.

Ringbone is a bony growth found just above the coronet or a little higher. The growth forms on the large round bones of the pastern, usually in the fore limb. It causes lameness by pressure on the tendons of the lower limb, or in its worst form the new bone formation may develop in the region of the joint and interfere with the free movement of the digits. In such cases permanent lameness results.

These enlargements in the bone are quite apparent when the pastern is examined manually. Frequently they may be obvious to the eye.

Mares with ringbone should not be used for breeding purposes.

Sidebone.

Sidebone is due to the disposition of bony material in the cartilages situated in the region of the heel of the hoof just above the coronet.

Normally these cartilages have a certain amount of free movement under pressure and help to sustain the jar when the horse is working on hard surfaces.

When sidebone develops, however, the cartilages become quite firm and will not yield to pressure.

Sidebone is common in draught horses in Queensland. It is only when the growth becomes extensive that it will produce permanent lameness.

As in the case of ringbone, mares suffering from sidebone should not be used as breeders.

DISEASES OF THE HOOF.

Formerly, when the horse was used for transport work in cities and towns, animals were frequently stabled under crowded, unhygienic conditions. These conditions combined with long hours of heavy, fast work on hard pavements rendered the feet susceptible to a number of diseases. These diseases are of less importance in the case of farm horses kept under healthy farm conditions and working on soft roads, and for this reason will be mentioned only briefly in this article.

Greasy Heel.

This is a chronic dermatitis affecting the skin behind the heel and pastern. It may extend up to the knee or hock. Its cause is unknown, but probably starts from some superficial injury to the skin of the affected area.

The skin becomes hot, swollen and painful, and a fatty evil-smelling discharge forms on the surface of the skin. As the disease progresses soft, greasy, wart-like growths develop.

The affected area must be thoroughly cleansed twice a day and dressed with 10 per cent. zinc sulphate and alum solution. It may be necessary to remove warty growth by surgical means. The condition is very resistant to treatment, and only constant prolonged attention is likely to produce good results.

Quittor.

This is the name given to that condition in the foot in which pus forms under the sole or behind the wall of the hoof and forces itself out through the top of the coronet, usually in the region of the heel.

The original cause may be anything from a bruise to a picked-up nail. Successful treatment depends on radical surgery for the original cause, combined with good drainage and irrigation with solutions such as 20 per cent. zinc sulphate.

Seedy Toe.

A dry, seedy condition of the hoof wall in the region of the toe. It is generally considered to be due to bruises to the wall setting up a gangrenous condition between the hoof wall and the laminae of the hoof. It is possible that there is also a nutritional factor involved.

Treatment consists in removing surgically all mealy material, then packing the cavity with cotton wool impregnated with a paste containing iodoform and boracic powder. The hoof is reshod over the packing.

Canker.

Canker is a condition which causes gangrene and sloughing chiefly in the region of the frog, but also extending to neighbouring parts of the sole. It sets up a chronic inflammatory condition in the deeper tissues preventing the deposition of normal hoof tissue. Wet, muddy conditions are apparently essential to the development of canker.

The foot should be cleaned and the infected horn tissue removed. The prepared hoof is bathed for long periods each day in a 1 per cent. solution of iron sulphate. The hoof is then packed with cotton wool soaked in 20 per cent. zinc sulphate, and as recovery takes place this packing can be replaced by powdered bluestone. The horse should be kept in a dry stable.

Thrush.

Thrush is another condition affecting the frog. There is inflammation together with ulceration associated always with a most offensive discharge. The frog may come completely away. Like canker, thrush develops only under wet conditions.

Removal of gangrenous material from the frog and stabling the horse under dry conditions are sufficient to effect a cure.

Corns.

Corns commonly affect the front feet, but may occur on all four feet. They are usually caused by ill-fitting shoes, especially when the horse is used on hard roads.

They can be treated by correcting the shoeing errors and paring out the diseased horn. Maltreated, the corn may become infected and develop into quittor.

Laminitis (Founder).

This is an aseptic inflammatory condition of the sensitive structure within the hoof. It usually affects all four feet at the one time. The condition may be chronic or acute.

Laminitis may result from a number of causes—such as long tiring journeys, overfeeding on grain, wheat engorgement, super-purgation, or toxaemia from any cause.

The symptoms vary according to whether the case is acute or chronic. In acute cases the horse will stand with his front legs stretched out in front of him and the hind legs tucked well under the body, supporting as much weight as possible on the heels. There will be a considerable fever and patchy sweating.

Chronic cases usually result from acute cases which have made partial recovery. There are characteristic changes in the wall of the hoof, which becomes elongated and narrow. From the coronet the wall grows almost vertically downwards and towards the toe it grows at a horizontal angle. Rings form on the wall parallel with the coronary band. The sole of the hoof drops and the horse walks on his heels, producing a gait characteristic of chronic laminitis.

As soon as the condition is diagnosed the horse must be treated with a powerful purgative and he should be stood with his feet in cold water. If a cold stream is available the horse can be tied in the water. No stream being available, packs cooled by ice should be applied to the feet.

The original cause should be sought out and removed as soon as possible. If this is done before the condition is far advanced many cases of acute laminitis will respond well to the above treatment. Chronic cases are rarely suitable for treatment. It is best to give horses so affected, light slow work. If this is done it will be found that those horses with less pronounced deformities can be quite useful.

WOUNDS AND INJURIES.

Contused and Open Wounds of the Foot.

These conditions vary in their seriousness according to the extent and position of the injury.

Where the injury is slight, lameness may disappear in the course of a few days. In the severest form the hoof may be completely torn

off and in such cases it will be necessary to devote some months to the nursing of the wound before the horse can be allowed out to fend for himself. Injuries to the bone within the hoof may produce a permanent lameness.

Injury to the anterior or middle regions of the foot are usually more serious than injuries about the heel.

Treatment consists of the use of antiphlogistic and antiseptic applications. In very severe cases it may be necessary to "sling" the horse. Initially the foot should be irrigated for from 12 to 24 hours with cold water. This should be followed by prolonged hot fomentations. In the case of open wounds all ragged tissue must be removed surgically. The wound should be cleansed with a weak antiseptic solution and filled with five per cent. sulphanilamide in boracic acid powder.

Subsequent treatment will depend on the initial healing processes. If possible the wound should be kept dry and packed with powder each day, but if infection sets in and pus pockets form then adequate drainage must be supplied by surgical means and the wound irrigated with large quantities of hypochloride solution, dried, and again packed with five per cent. sulphanilamide powder.

Picked-up Nail and Open Wounds of the Sole.

This type of injury can be very serious if correct treatment is not adopted immediately the injury takes place, but provided treatment is undertaken early, rapid recovery results.

As soon as the location of the injury is ascertained the hoof should be cleansed with weak lysol solution and the wall of the sole removed for a distance of one quarter inch around the nail puncture. This allows ample space for drainage. The hole so formed should be plugged with cotton wool soaked in hydrogen peroxide.

In cases where the wound has become infected and pus has formed under the sole it may be necessary to strip large areas of the horn in order to afford good drainage. The farmer should not hesitate to remove large areas of the horny sole. Little harm can be done by removing too much, but frequently if the surgeon is over-cautious pus pockets will form far under the hoof and eventually a stubborn case of chronic quittor will result and the horse will be rendered useless.

If the sole is bare it should be dressed with cotton wool soaked in 10 per cent. zinc sulphate and the whole dressing kept in place by tying a bag over the hoof.

In all cases of wounds on the feet of horses, tetanus antitoxin should be injected in order to avoid the risk of tetanus developing.

A. H. Tucker, Government Printer, Brisbane.